U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-258 864

MODEL STATE INFORMATION SYSTEM FOR THE SAFE DRINKING WATER PROGRAM

FEASIBILITY STUDY FOR DEVELOPMENT AND IMPLEMENTATION OF A MODEL STATE INFORMATION SYSTEM FOR EPA's SAFE DRINKING WATER PROGRAM

American Management Systems, Incorporated,
Arlington, Virginia

Prepared for
Environmental Protection Agency,
Washington, D.C.

15 June 1976

296078

PB 258 864

EPA - 570/9-76-002-5

FEASIBILITY STUDY FOR DEVELOPMENT AND IMPLEMENTATION OF A MODEL STATE INFORMATION SYSTEM FOR EPA's SAFE DRINKING WATER PROGRAM

PREPARED FOR THE OFFICE OF WATER SUPPLY

ENVIRONMENTAL PROTECTION AGENCY

June 15, 1976

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

EPA REVIEW NOTICE

This report has been reviewed by the Environmental Protection Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendations for use.

BIBLIOGRAPHIC DATA SHEET	1. Report No. EPA-570/9-76-002-5	2.	3. Recipient's Accession No.

4. Title and Subtitle
Feasibility Study for Development and Implementation of a Model State Information System (MSIS) for EPA's Safe Drinking Water Program

5. Report Date
June 15, 1976 (Date of Approval)

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
American Management Systems, Inc.
1515 Wilson Blvd.
Arlington, Va. 22209

10. Project/Task/Work Unit No.

11. Contract/~~Grant No.~~
68-01-1968

12. Sponsoring Organization Name and Address
Office of Water Supply (WH-550)
U.S. Environmental Protection Agency
Washington, D.C. 20460

13. Type of Report & Period Covered
Final

14.

15. Supplementary Notes

16. Abstracts

See Attached

17. Key Words and Document Analysis. 17a. Descriptors

Model State Information System, MSIS, Water Supply Safe Drinking Water Program, Reporting, Water Quality Monitoring, Data Management.

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

PRICES SUBJECT TO CHANGE

18. Availability Statement
No Restriction on Distribution
Available from National Technical Information Service, Springfield, VA. 22161

19. Security Class (This Report)
UNCLASSIFIED

20. Security Class (This Page)
UNCLASSIFIED

21. No. of Pages
127

22. Price
$6.00

Abstract

The Model State Information System (MSIS) is a computer-based information system which can be utilized by individual States and/or EPA Regions to perform the minimum data management functions mandated by the Safe Drinking Water Act of 1974 (PL 93-523).

Three major documents were produced by American Management Systems, Inc., for EPA outlining the basic concepts of an informational data management system to meet the water quality monitoring and reporting requirements of the Act. These include:

(Document 1) *Feasibility Study for Development and Implementation of a Model State Information System for EPA's Safe Drinking Water Program*. June 15, 1976

(Document 2) *Introduction to the Model State Information System (MSIS)*. June 15, 1976

(Document 3) *Model State Information System for Safe Drinking Water Program*. June 15, 1976. 3 volumes

The South Western Ohio Regional Computer Center (SWORCC) has been engaged by EPA to perform the detailed system design, programming, testing, and documentation of the MSIS. The detailed development phase is currently underway, and all work should be completed by early March 1977.

The MSIS consists of eight subsystems: (1) Public Water Supply Inventory; (2) Water Quality Compliance; (3) Regulations; (4) Federal Reporting; (5) Variances and Exemptions; (6) Enforcement Actions; (7) Sanitary Survey; and (8) Operator and Mailing.

The first four subsystems comprise the basic package, which is required if any portion of the MSIS is to be used. States may select the base package and one or more optional sub-systems, depending on their volume of data and individual needs.

PREFACE

This report presents the findings of a feasibility study for development and implementation of a model state information system for EPA's Safe Drinking Water Program. The conceptual basis for this information system is described in Program Evaluation Requirements, Concepts and Plans for the EPA Safe Drinking Water Program, Office of Water Supply, EPA, October 1975. And the general design of a customized Model State Information System is contained in four volumes supplied to EPA concurrently with this report. Details regarding the various subsystems, inputs, outputs and file structures are presented in these volumes and are therefore not repeated here.

TABLE OF CONTENTS

Page

PREFACE i
EXECUTIVE SUMMARY 1
Table ES-1: State Preferences for MSIS 2

Key Findings 3
Summary of Costs 5
Table ES-2: Estimated Development Costs of a Model State Information System for the Safe Drinking Water Program. 6
Table ES-3: Estimated Installation Costs of a Model State Information System for the Safe Drinking Water Program. 7
Table ES-4: Estimated Operating Costs of a Model State Information System for the Safe Drinking Water Program. 9

I. Introduction and Problem Definition. 10

II. Objectives of the Analysis 12

III. The Analysis Approach. 14

IV. Description of Major Outputs 17

Presentation of the Feasibility Analysis, Implementation Schedules Resource Requirements, and Estimated Development and Operation Costs. 18

V. Administrative/Technical Evaluation. 20

A. Views and Desires of the States. 20

1. States' Views on a Centralized System. 21
2. States' Ability to Acquire and Use a Custom System 22
3. Success Through Support. 23

TABLE OF CONTENTS
(continued)

Page

B. Computer Hardware Considerations 23

1. Centralized Computer Facility. 23
2. Decentralized Computer Facilities. 25
3. Computer Software Considerations 26
    a. Centralized Custom Package 27
    b. Decentralized Custom Package 27
    c. Centralized STORET Option. 28
4. Administrative Issues. 29
    a. Human Resources. 29
    b. Data Input Responsibilities. 29
    c. Who Bears the Cost of a Centralized System?. 30
5. Administrative/Technical Evaluation Summary. 30

VI. MSIS Development and Installation: Task Definition, Resource Requirements, Schedule and Cost Estimates. 31

Major Next Steps 31
Resource Requirements. 31

Table 1: Comparison of Resources Required for the Development of MSIS Under Three Major Options. . . . 33

Implementation Schedule. 34
Cost Estimates 35

VII. Annual Operating Costs of the MSIS 37

Key Assumptions. 37
Approach 38
MSIS Operation Costs 38

Table 2: Estimated Annual Operating Costs of the Model State Information System - Basic Package Only 39

TABLE OF CONTENTS
(continued)

Page

Minimum Requirements for a Computerized MSIS 40

Table 3: Minimum Requirements for a Computer-Based MSIS 42

Total Annual Costs 43

Table 4: MSIS Annual Operating Costs 44

APPENDIX 1: Estimated Resource Requirements for MSIS Development 45

Estimate of Module-Dependent Tasks 45

Exhibit 1.1 : Task List for Detail Design of a Custom MSIS 47

Exhibit 1.2 : Task List for Programming and Testing of a Custom MSIS 49

Exhibit 1.3 : Task List for Installation of a Custom MSIS at the States 50

Exhibit 1.4 : Module Evaluation Table 53

Exhibit 1.5 : Distribution of Modules by Evaluation Points 56

Exhibit 1.6 : Estimate of the Most Likely Level of Effort for Development of Typical Modules 57

Exhibit 1.7 : Conservative Estimate of the Level of Effort for Development of Typical Modules 58

APPENDIX 2: Resource Allocation Plan for the Development of a Custom MSIS 59

Exhibit 2.1 : Task Plan for MSIS Detailed Design Estimate of Most Likely Level of Effort 60

Exhibit 2.2 : Task Plan for MSIS Programming Estimate of the Most Likely Level of Effort 61

Exhibit 2.3 : Task Plan for MSIS Detailed Design - Conservative Estimate of Level of Error 62

Exhibit 2.4 : Task Plan for MSIS Programming - Conservative Estimate of Level of Effort 63

TABLE OF CONTENTS
(continued)

Page

APPENDIX 3: Detailed Explanation of MSIS Annual Operation Cost Estimate 64

1. Introduction. 64
2. Cost Computing Program Description. 64
   a. Computation of Computer Related Costs. 64
   b. The Cost Computation Program 65
      1. Function. 65
      2. Input 65
      Exhibit 3.1 : CPU Time Estimation Methodology 66
      Exhibit 3.2 : AMS Computer Center Schedule B - Equipment, Services and Rates 67
      Exhibit 3.3 : MSIS Report Table 69
      Exhibit 3.4 : MSIS Files Table. 73
      Exhibit 3.5 : MSIS Module Table 80
      3. Output 84
      4. Process. 84
      Exhibit 3.6 : An Example of the Output of the Cost Computation Program. 85
   c. The State Data Preparation Program 86
      1. Function 86
      2. Input. 86
      3. Output 86
      4. Process. 86
      Exhibit 3.7 : Number of Runs Per Year By Module and State Size 87

TABLE OF CONTENTS
(continued)

Page

3. Volume Estimates 88

- Permanent Files. 88
- Input Transactions 88
- Bacteriological Samples. 89
- Turbidity Samples. 89
- Chemical and Radioactive Samples 89
- Sample Computation Worksheet 89

Exhibit 3.8 : Volume Estimates for Key Files and Tables. 91

4. Annual Cost Computation. 92

- Computer Time Costs. 92

Exhibit 3.9 : MSIS Annual Computer Time Costs 93

- Data Preparation Costs - Keypunch. 94

Exhibit 3.10: Data Preparation Costs: Keypunch 95

- Data Preparation Cost - Personnel. 96

a. Sample Data. 96
b. Other Transactions 96
c. Error Correction 96

Exhibit 3.11: Data Preparation Costs: Personnel. . 97

- Continuous Paper Cost. 98
- Magnetic Tapes and Disks Cost. 98

Exhibit 3.12: Continuous Paper Costs Per Year . . . 99
Exhibit 3.13: Annual Costs for Tapes and Disks. . . 100

- Teleprocessing Costs 101

Exhibit 3.14: Annual Data Volume Estimates for a Centralized MSIS. 102
Exhibit 3.15: Mainframe Additional Costs for a Centralized MSIS. 103

TABLE OF CONTENTS
(continued)

Page

- Operation Cost Under the STORET Option 104

  Exhibit 3.16: Annual Operation Cost Per PWS for STORET Option 104

- Technical Assistance 105

  a. Decentralized MSIS 105
  b. Centralized MSIS 105
  c. STORET Option. 106

  Exhibit 3.17: Annual Cost of Technical Assistance. 107

- Comparison 108

  Exhibit 3.18: MSIS Options Comparison Table 109

- Total Operation Cost 110

  a. MSIS Installation Assumptions. 110
  b. Assumptions About Cost Per PWS 110
  c. Other Assumptions. 111
  d. Annual Operation Costs 112

  Exhibit 3.19: Annual Operation Costs Under Custom Decentralized MSIS 113
  Exhibit 3.20: Annual Operating Costs Under Custom Centralized MSIS 114
  Exhibit 3.21: Annual Operating Cost Under STORET Option 115

FEASIBILITY STUDY FOR DEVELOPMENT AND IMPLEMENTATION OF A MODEL STATE INFORMATION SYSTEM FOR EPA's SAFE DRINKING WATER PROGRAM

EXECUTIVE SUMMARY

The Safe Drinking Water Act of 1974 greatly expands the U.S. Environmental Protection Agency's responsibilities for monitoring the quality of drinking water in the United States. The Act enfolds all public water systems under the regulatory umbrella of EPA, but provides for a joint federal-state enforcement system for ensuring the quality of drinking water.

Under the authority invested in EPA by the Act, the first set of regulations entitled "National Interim Primary Drinking Water Regulations" were issued in December 1974. These regulations established maximum contaminant levels for specified contaminants and prescribed procedures for sampling and monitoring water quality beginning June 1977. Although most states already have some form of program to monitor drinking water quality, the extensive sampling and reporting requirements prescribed by EPA will significantly increase the administrative and regulatory burden at the state and federal level.

A preliminary survey of selected states in 1975 confirmed the EPA's belief that a computer-based information system would be required by most states to effectively monitor the program. Rather than have individual states embark on separate paths toward computer system development, the U.S. EPA decided to develop a Model State Information System (MSIS) to assist the states and regions in implementing the program.

A key decision in the implementation of this MSIS is whether the system should be made available to the states to operate on computer facilities of their choice, or the system be installed only at the central EPA computer facility, accessed by the states and regions through telecommunications. This analysis was undertaken to assist EPA in making this determination.

American Management Systems, Inc. (AMS) analyzed the feasibility, resource requirements and cost estimates for developing, installing, and operating the MSIS under three systems options:

- a decentralized custom MSIS developed specifically to address the minimum requirements of the Safe Drinking Water Program and made available to states to operate on a facility of their choice; the system would be supported by the central EPA facility for use by regions and states choosing the central EPA facility.
- a centralized custom MSIS developed as in option 1 but supported only at the central EPA facility, and
- a centralized MSIS based on STORET, the general purpose data storage and retrieval software used in monitoring water quality.

As an important part of the feasibility analysis, AMS visited 24 states and the 10 EPA Regional Offices. Our analysis is based on the data collected at these site visits. Following the site visits, EPA obtained critical information on state preferences and data processing capabilities through a simplified questionnaire administered by the regions to states not included in the original sample. This additional data generally supports the information collected in the survey.

As Table ES-1 shows, 31 of the 40 responding states indicated a strong preference for a decentralized system, with 22 states essentially agreeing to use an EPA developed MSIS. Most of the six states desiring a centralized MSIS stated that they do not have ready access to a state computer system.

TABLE ES-1

STATE PREFERENCES FOR MSIS

	Number of Responses
Decentralized System	
• EPA developed MSIS	22
• state developed system	6
• manual system	3
Sub-total	31
Centralized System	
• STORET-based MSIS	2
• EPA developed MSIS	4
Sub-total	6
Data not available	3
TOTAL All Responses	40

Key Findings

A vast majority of the states surveyed indicated a very strong preference for the decentralized custom MSIS. The states generally prefer to have the system under their control, especially a routine operational system for a program the states are responsible for monitoring. Individual states will undoubtedly wish to extend the use of the MSIS to suit their specific requirements; this tailoring is probably best accomplished in a decentralized system. One of EPA's major concerns regarding MSIS was the ability of state data processing capabilities to support a decentralized MSIS. Our survey and analysis indicate that by and large most states possess the ADP capability and the capacity to operate and maintain such a system. 21 of the 40 states responding to our survey reported OS based IBM facilities; 11 states reported other manufacturer's hardware, and eight were unable to provide data on their data processing capabilities. Finally, in terms of cost analysis for development and operation, our estimates show that the decentralized custom system would cost less to develop and operate.

Our estimates show that the development of the custom MSIS would cost between $183,000 and $231,000 for contracted professional services; in comparison, the STORET-based MSIS would cost about $204,000 if developed under contract with an outside vendor. The STORET group estimates development costs of about $128,000 for in-house development of a STORET-based MSIS, the major difference being in the substantially lower daily rates used. However, EPA does not have the resources to develop an MSIS in-house and the STORET group estimates a requirement for three additional people who would then need to be trained in the use of STORET.

The decentralized operation is especially attractive since it does not create a huge demand on the federal EPA for continuing system support, computer facilities, and the problems of managing a complex telecommunication-based system.

The volume of data to be processed by the MSIS is considerable (estimated daily volume of 26,000 transactions nationwide when the non-community systems are included) and if the centralized option is selected, it will result in a system roughly the size of the current STORET system of EPA's central facility.

For these reasons, we feel that the decentralized custom system will best serve the intent of the Safe Drinking Water Program. However, the development of an MSIS is a major undertaking, especially considering the time schedule imposed by the regulations -- June 1977. Continuous and effective project management will ultimately determine the success or failure of this endeavor, especially the manner in which the system is tested centrally before being delivered to the states for installation, and the initial support provided by the federal EPA to the states and regions. One of the chief reasons for the problems encountered by EPA in developing decentralized systems in the past has been the lack of adequate systems testing before installation at the state level. In order to assist the EPA to effectively manage the development, testing, and installation of MSIS, we have provided as part of this effort a detailed task plan and schedule for each step in system development.

Option 2 of the centralized custom MSIS offers no significant advantage over the decentralized option, especially since it will be almost impossible to withhold the software from a state that requests it. The administrative structure, computer facilities, and the telecommunications network require not only a significant front-end investment but also a high level of continuing effort by the federal EPA. And there is no guarantee that states will use the centralized system. Generally, a centralized data base is effective if several different users require immediate access to most recent and detailed data. In this instance, the federal EPA or other states do not need immediate access to detailed data maintained for an individual state; EPA's major role is that of providing the support needed to initiate the program and keep it functioning effectively at the state and regional level. This is best accomplished through a decentralized custom system.

The final option of using STORET to perform the data storage and retrieval functions of an MSIS also suffers from all the drawbacks outlined for the centralized system. In our judgment STORET is not suitable for a production-type management information system. It was designed to process parametric data, and performs its intended functions effectively and adequately.

To try and adapt it for an application it was not designed for surely decreases the probability of obtaining an operational system to serve the needs of the Safe Drinking Water Program. Additionally, the EPA does not currently possess the required manpower resources to develop a STORET-based MSIS. The knowledge of STORET is not a generally available commodity so even if additional persons are added to the internal staff, or the development is contracted out, there would be at least some time lag before these individuals can be comfortable enough with the STORET environment to design and develop an MSIS based on STORET. The schedule imposed by the National Interim Primary Drinking Water Regulations renders each day critical for MSIS development. The problem is further complicated by the lack of adequate documentation of the STORET software.

Thus, in balance, we feel that the decentralized custom MSIS represents EPA's best chances for a successful system; however, we once again stress the strong need for effective management of the system development if MSIS is to be ready for use by at least some states in June 1977.

Summary of Costs

An important part of analysis focused on the costs of developing, installing, and operating an MSIS under each major option. Table ES-2 summarizes MSIS development cost estimates for a custom system and the STORET-based option. Resource requirements for MSIS development (in terms of person-months) are estimated to be roughly the same for both options of the MSIS; as a result, the cost to EPA of developing the system under contract will be roughly similar under either option. The in-house development cost estimate for the STORET option is based on an internal price which does not take into account the fact that additional resources acquired for this development effort represent a cost in perpetuity to EPA.

TABLE ES-2

ESTIMATED DEVELOPMENT COSTS OF A MODEL STATE INFORMATION SYSTEM FOR THE SAFE DRINKING WATER PROGRAM

($000)

	Custom System (decentralized or centralized)	STORET-based System
Concept Study	$ 20	$ 20
Feasibility Study	120	120
Total to date	$140	$140
Design and Development (Professional services only)		
• Under Contract	$183-$231	$204
• In-house	N/A	128
Total Costs		
• Contracted development	$323-$371	$344
• In-house development	N/A	$268

Table ES-3 below summarizes the estimated installation costs for each option of the MSIS. According to our estimates, installation costs for the STORET-based MSIS would be roughly the same as those for a centralized custom system since in our judgment, the success of the system depends to a large degree on the manner in which it is installed. An additional factor to consider in the installation of a STORET-based MSIS is the availability and training of installation teams. The people in the states who have a working knowledge of STORET are not necessarily the ones who will use MSIS, therefore the ultimate users will require training; even with the three additional people estimated to be required for developing an in-house STORET-based MSIS, the resource requirements for installing the system at states will not be met.

TABLE ES-3

ESTIMATED INSTALLATION COSTS OF A MODEL STATE INFORMATION SYSTEM FOR THE SAFE DRINKING WATER PROGRAM

	Decentralized System	Centralized System (custom and STORET options)
Estimated Person-days		
• General tasks for all states	38	38
• Average per state	55-66	49
Total Person-days for 49 installations	2,978	2,439
Estimated Cost @ $200 per day	$595,600	$487,800

Finally, our estimates for the ongoing operating costs of MSIS are displayed in Table ES-4. The table contains our estimates of required manpower as well as data input and computer operating costs for the basic package and full MSIS for the first and third year of operations. Our estimates show that for the decentralized system, EPA will need a full-time person at the center and approximately three-quarters of a full-time person at the regions. Operating costs under the decentralized system will range from an estimated $704,000 in the first year for the basic package to $2.1 million in the third year for the full package. In the long run, the full package estimates constitute more reasonable planning guides since the states will probably extend the applications of MSIS as they become more familiar with it. Centralized options are estimated to make significantly more demands on resources at EPA headquarters and regions; moreover, operating costs are estimated to be higher in the centralized options chiefly because of the administrative and technical problems in interfacing with a centralized facility.

* *

In conclusion, therefore, we find that:

- Estimated operating costs are not significantly different under any option for the MSIS,

- Systems development and installation costs would be significantly lower if EPA developed and installed the system with in-house resources; however, EPA does not have adequate resources to effectively accomplish this task,

- If the development of MSIS is contracted out, the costs of development and installation are estimated to be roughly similar under any selected option,

- Therefore, on a cost basis, no single option would provide an overriding reason for its selection.

- On the other hand, the intent of the legislation, its intent for joint federal-state enforcement, and the states' preferences and data processing capabilities argue very strongly for a decentralized custom MSIS.

TABLE ES-4

ESTIMATED OPERATING COSTS OF A MODEL STATE INFORMATION SYSTEM FOR THE SAFE DRINKING WATER PROGRAM

OPTION	FULL MSIS				BASIC MSIS			
	1st Year		3rd Year*		1st Year		3rd Year*	
	People	$000	People	$000	People	$000	People	$000
Central EPA Cost:								
Custom Decentralized	1.75	35	1.75	40	1.75	35	1.75	40
Custom Centralized	9.00	180	9.00	207	9.00	180	9.00	207
STORET	8.00	160	8.00	184	8.00	160	8.00	184
Total Cost for States:								
Custom Decentralized	24.00	842	58.00	2,076	19.00	669	52.00	1,690
Custom Centralized	18.00	823	46.00	2,048	13.00	628	40.00	1,618
STORET	18.00	804	46.00	2,003	13.00	614	40.00	1,580
Total National Cost:								
Custom Decentralized	25.75	877	59.75	2,116	20.75	704	53.75	1,731
Custom Centralized	27.00	1,003	55.00	2,255	22.00	808	49.00	1,825
STORET	26.00	964	54.00	2,187	21.00	774	48.00	1,764

*Including 15% for cost increase due to inflation.

I. INTRODUCTION AND PROBLEM DEFINITION

The primary objective of the Safe Drinking Water Act of 1974 is to assure that water supply systems serving the public meet minimum national standards for the protection of public health. Prior to the enactment of this legislation, the U.S. Environmental Protection Agency was authorized to prescribe federal drinking water standards only for water supplies used by interstate carriers; moreover, these standards could only be enforced for contaminants capable of causing communicable diseases.

The Safe Drinking Water Act of 1974 authorizes the U.S. Environmental Protection Agency (EPA) to establish federal standards for all harmful water contaminants and extends the applicability of these standards to all public water systems. The first set of regulations entitled "National Interim Primary Drinking Water Regulations" were issued in December 1974. These regulations establish maximum contaminant levels for specified contaminants and establish procedures for sampling, testing and monitoring water quality. The regulations also categorize the public water systems into "community" and "non-community" systems. Public water systems that serve at least 15 service connections used by year-round residents, or serve at least 25 year-round residents are defined as community systems; these systems are required to monitor their water quality as specified in the regulations beginning 18 months after the regulations are issued, i.e. from June 1977. "Non-community" water systems are those that essentially serve a transient population; examples include hotels, motels, restaurants, campgrounds, service stations and other public accommodations that have their own water system with at least 15 service connections or serve water to at least 25 persons on average each day. Recognizing the operational difficulties in monitoring the vast numbers of these non-community systems, the regulations provide an additional two years after the effective date of the regulations to begin monitoring, i.e. from June 1979.

A distinguishing feature of the Safe Drinking Water Act is the reliance on a joint federal-state system for assuring compliance with the regulations. The intent is to encourage the states to assume primary responsibility for operational monitoring of the water quality program and submit specified data annually to the federal EPA. Although most states have some form of program under state law for monitoring drinking water quality, and although the national standards require monitoring initially only of community systems, a recent AMS study[1/] demonstrated the strong need for a computer-based management information system to assist the states and EPA regions to perform their mandated monitoring functions.

A preliminary survey of selected states confirmed EPA's belief that a computer-based information system was essential to the success of the program and a conceptual framework of a management information system for the Safe Drinking Water Program was developed in the previous study. Rather than have each state embark on a costly and time-consuming effort to design and develop a computer system for the program, the federal EPA decided to develop a "minimum requirements" package that would meet program needs and serve as the basic building block for future expanded use.

Once the decision was made to develop a Model State Information System (MSIS) for the Safe Drinking Water Program, the most critical question was whether the system should be developed for the states and EPA regions to operate on a computer facility of their choice, i.e. a state-owned computer, other local facility or a central EPA facility, or the system should reside on a central EPA facility and enable the states and regions to access it via telecommunications.

Since the design, programming and installation of the system can be very different depending on the centralized or decentralized option selected, EPA engaged the services of American Management Systems, Inc. to conduct a feasibility analysis of the major systems options.

[1/] Program Evaluation Requirements, Concepts and Plans for the EPA Safe Drinking Water Program, Office of Water Supply, EPA, October, 1975.

II. OBJECTIVES OF THE ANALYSIS

The primary objective of this endeavor is to analyze the feasibility costs and resource requirements of the following three major options of an MSIS for the Safe Drinking Water Program:

1. Decentralized Custom System - Develop an MSIS for the states and EPA regions to install and use on a computer facility of their choice, e.g. a state-owned computer, other local facility or central EPA facility. The system would be as machine independent as possible and developed in a high level programming language (COBOL) that is supported by most hardware manufacturers.

2. Centralized Custom System - Develop a tailored MSIS for the Safe Drinking Water Programs, on a central EPA facility and provide access to the states and EPA regions via telecommunications. The federal EPA would then be responsible for all future maintenance of the system.

3. Centralized MSIS under STORET - Develop an MSIS using STORET to perform the basic data storage and retrieval functions and to store Public Water Systems (PWS) inventory information. STORET is a general purpose data storage and retrieval software developed by EPA and is currently used to monitor the quality of water sources in the USA.

The analysis seeks to provide information to enable EPA management to decide which option offers the greatest probability of successful implementation and operation, and provides estimates of costs and resource requirements for developing, installing, and operating the MSIS under each option.

In order to accomplish this objective, the administrative and technical capabilities of the EPA central office, EPA regions and states are evaluated in their ability to adequately support an MSIS under each option, and the development and operative costs under each option are estimated.

III. THE ANALYSIS APPROACH

Our approach to the comparative analysis of the feasibility, costs and benefits of the three systems options comprised the following key elements:

1. A definition of system requirements - The first step in the analysis was to define the inputs, outputs, files, processing steps and timing requirements of an MSIS for the Safe Drinking Water Program. This definition, often referred to as a "general design" of an information system, serves two purposes:

    - it forms the basis for evaluating the technical and administrative feasibility of each system option, and enables the development and comparison of development and operations costs among the three major options, and

    - it facilitates the detail system and programming of an MSIS under the selected option.

2. Survey EPA regions and selected states - Since the system would be developed principally as a tool to be used by the regions and states, an important part of the feasibility analysis of various options is an evaluation of the administrative and technical capabilities of regions and states to effectively install and use the MSIS. This critical step is so often overlooked and leads to strained federal-state relations. Our approach, very simply, was that since the system is intended for use by EPA, the regions, and states, all these user groups should have an opportunity to provide inputs to the system design. That way, the system can be responsive to user needs and the probability of success is greatly enhanced since the development of the system is perceived as a cooperative effort by all user groups.

    Therefore, we conducted on-site interviews with central EPA personnel, all 10 EPA regions, and 24 selected states. We developed questionnaries to obtain information regarding the drinking water program in each state visited, and the Automated Data Processing (ADP) capabilities of each state and region visited. Additionally, we also developed a questionnaire to collect information on the problems associated with and the use of CDHS, where EPA designed and developed a computer system centrally and made it available to the states for use in their air quality programs.

Prior to the site visit, each region and state visited was sent a draft of the definition of system requirements for the MSIS, and the questionnaires so they could study the document and the information requested, and provide useful insights. The data collected at these series of visits has been provided to EPA and forms the basis for much of the feasibility and cost analysis presented in this report.

The 24 states were selected for site visits after extensive discussions with EPA staff and the intent was to include states with a sufficient number of public water systems that would be likely to implement the MSIS. Since it was felt that such a sample may bias the analysis, we developed a simplified version of the questionnaires which were later sent to the 10 EPA regions to collect data on all the states and territories not included in the site visits. The information supplied in these follow-up questionnaires generally supports the analysis and corroborates the more detailed information collected in site visits.

3. Conduct the feasibility analysis - Based on the information collected through these extensive interviews and the follow-up questionnaire, we evaluated the administration and technical feasibility of the three system options in terms of the preferences of the regions and states, and their capabilities to support an MSIS under each option. Included in this analysis is the evaluation of the capabilities of STORET and the centralized nature of a STORET-based system to meet the day-to-day operational requirements of an MSIS for the Safe Drinking Water Program.

4. Estimate resource requirements and schedule for MSIS implementation - An important element of our analysis as well as a critical piece of information for EPA management is the estimate of resource requirements and schedules for implementation of MSIS under each option. These estimates provide an indication of the magnitude of remaining tasks. Additionally, if adequate resources cannot be found to develop the MSIS under a specific option, the feasibility of that option is greatly reduced.

5. Estimate costs of MSIS implementation and operation - Since costs of development and operation are a key factor in the decision regarding the system option, we estimated the resource requirements and costs of detailed system design, computer programming and system testing, system start-up at the states and Regions, and system operation for each option. The resource requirements for the centralized system under STORET reflect the estimates of EPA's Data Processing and User Assistance Branch that is intimately familiar with the workings and capabilities of the STORET software.

6. Analyze results and present recommendations - The final key element of one approach is the overall evaluation of what does all the data, analysis and cost estimates mean for EPA management. Here we pull together the several strings into an overall assessment of the pros and cons of each option, make our recommendation as to which option is most likely to be successfully implemented, and summarize the reasoning to enable EPA to make a decision and proceed with the next steps in system development.

IV. DESCRIPTION OF MAJOR OUTPUTS

Since this analysis has resulted in several different products, a brief description of each highlighting their potential use is provided below:

1. An Executive Summary of the Feasibility Study for the Development and Implementation of a Model State Information System (MSIS) for EPA's Safe Drinking Water Program. This report summarizes for top management the key points of the feasibility and cost analysis contained in this report and presents our recommendation.

2. A Report on the Feasibility Study for the Development and Implementation of a Model State Information System (MSIS) for EPA's Safe Drinking Water Program. This is the principal deliverable of this analysis; it describes the problem, presents our approach, and displays the various feasibility analyses, cost computations, resource estimates and proposed schedules. The structure of the analysis presented in this report is described later in this section.

3. A Definition of System Requirements of a Model State Information System for the Safe Drinking Water Program. This document describes in four volumes the overall system structure and the various subsystems, input and output formats, file specifications, processing logic, and the data elements required for an MSIS. The four volumes comprise:

    - Introduction to the Model State Information System (MSIS) that presents the overall system structure and describes major sub-system functions.

    - Volume I: Subsystem Description describes the general design of each sub-system and its component modules.

    - Volume II: Exhibits displays input and output formats and the specifications for each major file in the system.

- Volume III: Data Element Dictionary contains the description of each data element in the system.

These MSIS requirements constitute the basis for detailed computer design of the MSIS. They are defined within the context of a custom system to enable us to estimate development and operation costs and resource requirements. However, the specifications are equally applicable to an MSIS under STORET; the major difference is the manner in which the files are structured and the types of computer programs developed to perform the functions of file updates and report generation.

4. The final output of the project is a thorough documentation of program and ADP information on the 10 EPA regions and 24 states included in the site-visits. This information has been summarized for EPA in a set of Summary Tables highlighting issues of special interest, e.g. numbers of public water systems, estimated reporting of violations, variations and exemptions, and the ADP facilities and resources available. In addition, all the Program, ADP, and CDHS Fact sheets used to collect this information from each site have been compiled into three volumes and delivered to EPA. These detailed back-up data can be used for a variety of purposes by EPA, the regions as well as the states.

Presentation of the Feasibility Analysis, Implementation Schedules Resource Requirements, and Estimated Development and Operation Costs

In the remaining sections of this document we present:

- an analysis of the administrative and technical feasibility of each MSIS option focusing on the stated desires of the states, the ADP and administrative requirements of each option, and the availability of resources centrally and at the states and regions to meet these requirements,
- an analysis of the resource requirements and feasibility of getting an operational MSIS under each option within the overall time frame established by the Regulations,

- an estimate of the operation costs of an MSIS under each option, and
- a conclusion summarizing the major issues and presenting our recommendation.

V. ADMINISTRATIVE/TECHNICAL EVALUATION

This section deals with those considerations which are not directly related to the factors in the cost analysis. In a project of this magnitude and complexity, costs are an important factor and certainly must be considered, but the overall success of the MSIS project is not completely based on cost. Success in this case is also very dependent on the cooperation and attitude of the primary users, the State's Water Supply personnel. In the ultimate analysis, they will determine the success or failure of the MSIS project. Therefore, it is quite appropriate for us to discuss and evaluate qualitative considerations not related to costs.

For the purpose of this discussion, the administrative and technical considerations have been divided into four major categories: the desires of the states, hardware considerations, software considerations, and administrative issues. The following text in this section discusses these criteria in detail.

A. Views and Desires of the States

The initial phase of the MSIS feasibility project involved personal visits to twenty-four State Water Supply Offices as well as the ten EPA regional offices. The purpose of these visits was to collect the most accurate data available on the state's water supply program, ADP facilities, reaction to the MSIS system and implementation options, and the state's views on the Safe Drinking Water Program. In all cases the state personnel were quite frank and very willing to supply the requested information and express their preferences. The results of this portion of the MSIS Feasibility Study have been compiled and documented in the following four volumes:

- MSIS State Program Fact Sheets, Books 1 and 2.
- MSIS State ADP and CDHS Fact Sheets.
- MSIS Regional and State Fact Sheet Summary Tables.

These documents can be referenced in the EPA Office of Water Supply. This section provides some insights on the views and concerns of the states.

1. States' Views on a Centralized System

There appears to be a strong trend both at the federal and state levels toward the states utilizing their own computer systems before resorting to outside facilities, including those provided by the federal government. This is a major factor for consideration in the development of an MSIS for EPA's Safe Drinking Water Program. An excellent example of the trend in state policies on computer utilization is the executive order of the Governor requiring all agencies in the state of Wisconsin to use the state's computer facilities to satisfy all their needs, and to justify thoroughly the proposed use of any external resources on the basis of extensive cost/benefit analyses for any such application.

In general, the states were pleased with the MSIS concept and thought the design would suit most of their needs. The states emphasized, however, that their needs would be best satisfied by a system installed on their own computer hardware. A centralized system would not provide them with the flexibility and immediate access that is often required in a management information system. If the system is centralized, access would be limited by having to use terminals and communication lines. The most limiting factor would be the speed of these terminals. Often this would mean reports would have to be printed centrally or at the regions and then mailed to the states. The reverse of this would place an unnecessary burden on EPA personnel and at the same time delay the availability of data and reports to the states.

Another concern is the states' dependence on the operating schedule for a centralized system. Files would be updated, reports would be produced according to a pre-established schedule and all users would be forced to abide by this schedule. Unless the schedule suits all the users' needs (and it may not), the timing could severely limit the usefulness of a management information system. Data must be processed, files updated, and reports produced according to individual needs which will certainly vary from state to state.

This lack of flexibility, the remoteness, and the dependence on EPA, all leave the majority of the states with the feeling that a centralized system will suit no one's needs, least of all their own.

2. States' Ability to Acquire and Use a Custom System

If a custom system is developed and installed centrally, the states will still have the option of acquiring the system and installing the system on their own computer. Since the system would be developed for the Federal Government, the states could get a copy from EPA and use it on their own. This fact is a realistic issue since most states expressed the desire to have the system locally. Little could be done to prevent the states from doing this.

On the other hand, if the custom system were made available on a local level, some guarantee could be made to ensure the basic concepts of the system were left intact. Although the states will probably want to modify the system to best suit their needs, to suit EPA's needs the basic package must remain intact. If EPA were to supply the system to the states, the state personnel would certainly want to be able to satisfy EPA reporting requirements by the easiest manner possible. The easiest way, of course, would be to have the computer produce a tape and merely send the tape to EPA. Since this capability is designed into the MSIS system, the states would certainly leave this portion intact to satisfy EPA in the easiest way possible. Other parts of the system could be changed, but the Federal reporting subsystem would remain as developed. In fact, those states that already have a suitable system stated that they would modify their systems to produce a tape in the proper format to meet the Federal reporting requirements. So by virtue of no effort is better than a lot of effort, the states will not want to lose the Federal reporting capability in the MSIS system.

3. Success Through Support

Regardless of the location of a water supply computer application, the only way the effort will succeed is for all concerned to be totally supportive of the entire effort. Much thought and consideration must be given prior to deciding where the MSIS system is to be implemented. If the Safe Drinking Water Program is going to succeed, EPA must have the support of every state. Part of this support can be acquired by carefully evaluating the needs and desires of the states and then basing decisions upon this evaluation. As it stands right now, most states want the MSIS system to be in their own computer and would be more apt to support EPA if this were the case.[1]

B. Computer Hardware Considerations

A point of great concern when evaluating the feasibility of a centralized or decentralized MSIS system is the one of computer hardware. A system like the MSIS system must be implemented on a readily available, responsive, and cost effective computer. Since there are basically two hardware options available, both must be considered in this study. This section contains a discussion on the issues relating to both options. The section has been broken down into two parts. The first part contains those issues surrounding the centralized hardware option, the second section contains the issues on the decentralized option. Here again, most facts were extracted from the information contained in the MSIS survey documents.

1. Centralized Computer Facility

There are several real concerns with the idea of installing the MSIS design on a central ADP facility. The major concern is one of volume. If all states are required to use a central facility the amount of data to be processed will be rather large. Using the survey as a basis, the ultimate number of public water systems (PWS) is estimated to be at least

---

[1] Of 40 states that were surveyed, 28 states preferred a local system, 6 preferred a centralized system, 3 preferred a manual system and 3 have no preference.

231,000. This means the PWS inventory file alone will contain more than 175 million characters. This is by no means a small file and will require at least one dedicated disk pack (200 million character capacity) to hold all the inventory data. Under the centralized option this file must be available to users throughout the day.

Problems associated with input transaction volumes are significantly more complex. With a PWS master file of 231,000 public water systems, all of which must be sampled periodically, samples analyzed and the results placed on a computer file, the amount of input data will be huge. A reasonable estimate of the number of samples is about 570,000 a month (See Appendix 3 for volume estimates). This estimate takes into account estimates for chemical, turbidity, and bacti samples for all community and non-community water systems. Assuming a 21 day month, 11 hours a day operation and including other transactions as well, this amounts to about 2,700 sample transactions which will need processing every hour, assuming an optimal schedule and even workload, which is not a good assumption, because all states will not submit sample data on a regularly scheduled basis. They would prefer to submit their sample data whenever it is convenient for them to do so. This means there will be large peaks and valleys where it will be virtually impossible to process the input. The data processing will have to be spread out over several days to accommodate the input volume. All in all there should be approximately 26,000 transactions that will require processing every day. This estimate far exceeds the number of transactions currently processed by the STORET system. This would mean that under a centralized concept one would eventually have a system larger than STORET in the next three years.

If the MSIS system is installed on the EPA computer facility, either as a custom package or under STORET, the amount of hardware required to support the system would have to be expanded dramatically over the next three years. Ultimately, the current STORET work load will be doubled under the centralized option. This does not mean the amount of hardware will have to be doubled, but it will have to be enlarged substantially to handle the volume. Certainly the current EPA facility will not be able to absorb the additional work load.

Another major issue with the centralized option is that input data will be transmitted over communications lines into the computer. This fact will further add to the work load of the computer. Transactions will have to be sent over telephone lines to the EPA computer, processed by the hardware, and responses or reports sent back to the users. This telecommunication function is pure overhead to the computer and further degrades its performance. Therefore, more hardware will have to be added to compensate for this degradation.

To further complicate matters, communication lines leave a lot to be desired and the transmission of data over these lines will at times be unreliable. Data will get lost, destroyed, or garbled and will have to be retransmitted. This can be a difficult situation considering the varied localities of the users. Often errors will go unnoticed or just ignored and the data will never get into the files thereby creating an incomplete data base. This can result in a system that will never suit anyone's needs. This type of activity will have to be continually monitored in order to prevent deterioration of the system.

Basically, the centralized option means that EPA will eventually end up with another computer system the size of STORET. All the costs and difficulties associated with a system of this size will have to be borne by EPA since the system will remain under their jurisdiction.

2. Decentralized Computer Facilities

The real question under the decentralized option is whether the states have a computer facility that is large enough to accommodate the MSIS system. According to our state surveys, 80% of the states surveyed had access to a computer large enough to handle the MSIS system. Those who did not could probably purchase computer time elsewhere or utilize the MSIS application installed on the EPA computer facility. In fact, not only do most states have a facility large enough to accommodate the MSIS system, but they also have enough excess capacity to absorb the additional work load easily. This means if the states were to acquire the MSIS system little or no additions or enhancements would have to be made to the computer facility.

A key issue to be considered in the decentralized option is the wide range of computers that will be used by the states. If the MSIS custom system is developed, rather than the STORET option, it will certainly be implemented on the EPA IBM facility. This means any state not having an IBM facility will require the MSIS system to be converted from the IBM version to another computer manufacturer's brand of hardware. Fortunately, most states have IBM hardware and the conversion effort would not be a major problem. In fact, only 11 out of the 33 states that had equipment large enough to handle the MSIS workload had computers other than IBM. In any case, the varied computers does not appear to be a large problem that cannot be solved for those states that do not have IBM computers. Since the MSIS system was designed with this in mind, the conversion from the IBM version to suit another vendor will also not be too complex. The system will be written in COBOL and is quite modularized, therefore the conversion should be smooth if adequately planned for and managed.

As far as computer hardware implications are concerned, the decentralized option is quite attractive. Under this option very little change or effects will be felt by the states' ADP facilities if the MSIS system were installed locally. Many state computers are IBM, big enough, and can handle the additional work load, and those that can not could use the system supported centrally by EPA.

3. Computer Software Considerations

Prior to deciding which installation option is the most feasible, one must explore the computer software area. In the software area there are three major choices to consider; STORET software centrally, a custom package centrally, and a custom package decentralized. Each of these are considered in the following text.

a. Centralized Custom Package

If the MSIS system is to be developed and installed centrally, the effort will be contracted out and done by an outside organization. This will leave EPA with the software support responsibility after the system has been installed. The problem here will be for EPA to acquire the personnel to support and maintain the MSIS system. From time to time errors will occur, enhancements needed, and numerous other software related modifications. The Office of Water Supply will be required to make these changes either internally or through a contractor. This will certainly be a full time job for 3 computer specialists for quite some time to come. This being the case, the Office of Water Supply will have to acquire software support and provide funds for computer time to maintain the MSIS software.

b. Decentralized Custom Package

If the MSIS system is installed at the state computer facilities, the problem here is not who will maintain the system, but who will be changing it. Certainly the states will sooner or later want to modify the system to better suit their needs. How do you ensure the states' systems will remain compatible with the EPA version? As mentioned previously, a real benefit to the MSIS system is the ability to generate a tape which will satisfy EPA's annual reporting requirements. This is a real advantage to the states and requires very little effort on their part. This is encouragement enough to believe the States will not change the basic package so that reporting requirements cannot be met. They will ultimately modify the system but the states wouldn't want to lose the automatic reporting capability. Any other changes would be of little concern as long as the states can report data to EPA in a standardized format.

c. Centralized STORET Option

There are two major concerns in the STORET software area. The first is the original design of the STORET system and the other is one of resource constraints.

STORET was originally designed to process and store parametric data; it was not designed to support a management information system. The MSIS system was designed to be a management information system that happens to use parametric data in some cases. In a management information system one must be able to immediately access up to date files and generate reports to make management decisions. This is not necessarily the case with STORET. Currently, files are updated only weekly and any large volume reports would have to be mailed to the states or transmitted by telephone lines. These delays may not be satisfactory for some management decisions.

Another concern is the fact that an enhanced version of the General Point Source File (GPSF) now called the Facility Reporting File (FRF) will have to be used to satisfy the reporting needs for the MSIS design. This version has not to date been tested in a production mode and the STORET personnel cannot guarantee its reliability. This may be a problem if this portion has not been fully tested by the time the states will be utilizing the FRF. Certainly a contractor who develops a custom package would be required to guarantee its reliability.

The second major consideration with the STORET option is, does the STORET group currently have the resources to design and implement the MSIS system in the required time frame? Currently they do not. This means they will have to acquire three new personnel (according to the STORET group estimate) to do this, or contract the effort out to outside concerns. In either case, probably neither will be trained in the STORET system and there could be a long learning curve until the new personnel were capable of designing and installing a system with the STORET software.

4. Administrative Issues

Although the major considerations have been discussed previously there are still some other issues that must be resolved by EPA personnel prior to deciding the centralization/decentralization issue.

a. Human Resources

A major requirement under the centralized option is one of addtional human resources. In order to fully support the day to day operations of a program this size, additional EPA staff will have to be acquired for both the regions and headquarters. The acquisition of personnel in the Federal Government is a long and tedious process and should be started as soon as possible. Some consideration should be given to this fact in conjunction with analyzing the feasibility of the centralized MSIS option. A staff as large as the current STORET staff may ultimately be required to give full support to a centralized MSIS operation.

b. Data Input Responsibilities

Under any implementation option a large part of the workload will be the actual input of source data. This responsibility will have to fall on either the individual states or the EPA regional offices. Some consideration should be given to this effort during the decision-making process on which installation option to choose. If the centralized option is selected, probably most states will want to send their source data to EPA for input. Because many states did not show particular interest in the centralized option, they could just view the system as "Washington's system" and assume very little responsibility to support the effort. If this is the case, EPA will be faced with keying and entering most of the source data for the states.

Under the decentralized option, those states that had the MSIS on their own computers would, of course, enter their own data. Those states who choose not to install the MSIS package would either use the system centrally or merely report to EPA on an annual basis as dictated by the regulations. In either case, the majority of the data preparation effort would be the responsibility of the states, not EPA.

c. Who Bears the Cost of a Centralized System?

If there is any hope for the majority of the states using a centralized MSIS system. EPA will probably have to bear the cost for operating the system. It is highly unlikely that a state would pay to use a system that they consider to be Washington's system. They may pay for terminals and communications costs, but surely not data processing costs. Ultimately EPA would end up with another operation similar to the current STORET cost arrangement.

If the states will send to EPA source documents rather than punched cards (or tapes), the cost of keypunching the data for all the states may be $559,000 annually and will also create complex managerial problems.

5. Administrative/Technical Evaluation Summary

IF EPA is going to maintain that the MSIS system is primarily for the states' use and benefit, then careful consideration must be given to the views and thoughts of each state. The states must be provided with a viable easy to use system that will assist them in the management of the Safe Drinking Water regulations. The system must be economical and responsive enough to provide the states with data so they may effectively manage their operations. The administrative and technical issues analyzed above argue strongly for a decentralized custom system that is developed and tested centrally but is operated by states on computer facilities of their choice.

VI. MSIS DEVELOPMENT AND INSTALLATION: TASK DEFINITION, RESOURCE REQUIREMENTS, SCHEDULE AND COST ESTIMATES

Major Next Steps

With the completion of this endeavor, EPA will have a description of the system requirements applicable to all options of MSIS. In addition, the specifications already developed also constitute what is termed as a "general design" for the custom package for the Safe Drinking Water Program, whether it be installed as a centralized system or on a facility of the state's choice. Major next steps toward obtaining an operational computer system under any option are:

1. Detail System Design,
2. Programming and Systems Testing on a central EPA facility, and
3. Implementation of the MSIS at the states and Regions. If the decentralized custom system option is selected, this step includes the task of installing the MSIS on a state or local facility for states that desire to do so. If either of the two centralized system options are selected, then this step involves training and assistance to the states and regions in the use of the centralized MSIS.

Resource Requirements

In order to estimate the resource requirements for each of the three major steps outlined above, we grouped the several tasks involved in each step into:

- overall system-related tasks, which include developing operating procedures and formats, manuals and guides, resolving detail design issues, etc., and
- module dependent tasks or those tasks directly related to the design, programming, testing and installation of computer programs.

We developed a general list of tasks to be accomplished in each group and estimated the resources required in person-days for each task under the decentralized custom system option. These estimates are also applicable to the centralized custom system option for the first two steps, namely detailed design, and programming, testing, etc. on the central EPA facility. In step three, i.e., installation at the regions and states, only the first group of tasks would be required under a centralized system since the computer programs would not be installed on local facilities.

The resource estimates shown for the centralized MSIS based on STORET were obtained from EPA personnel who have a working knowledge of the generalized software, its capabilities and limitations. We provided them with the system requirements document and the list of tasks we used for developing estimates for the custom MSIS and discussed the complexities of the system to assist these personnel in developing their estimates.

The resource requirements for detail system design, programming and testing, and "installation" at the states and regions are summarized in Table 1. EPA does not have the manpower to develop the MSIS internally under any option, therefore external resources are required, regardless of the option selected. The problem is further complicated for the centralized option under STORET by the fact that knowledge of STORET environment is not a generally available commodity and it would take a significant amount of time for additional personnel to acquire a working familiarity with the software. We believe that such a familiarity with the STORET environment must be achieved if any level of effectiveness is to be maintained when MSIS functions are added to a system with the magnitude and complexity of STORET. Moreover, adequate documentation on STORET is not currently available but is being developed under contract.

More detailed estimates by individual tasks are displayed in Appendix 1. According to these estimates, the detailed design of MSIS would require roughly the same level of effort under any option. The programming and testing of MSIS on a central EPA facility would require significantly more resources under the STORET option principally because of the large effort involved in documenting the STORET software. In the final step of installing the MSIS at the states and regions, our estimates for the custom system show that the bulk of the effort is expected to be in providing operations assistance to the states in terms of establishing procedures, schedules, formats, etc. and that the actual installation of the computer programs in the decentralized option would require an average of 6 to 15 person days per state. Although

Table 1

COMPARISON OF RESOURCES REQUIRED FOR THE DEVELOPMENT OF MSIS UNDER THREE MAJOR OPTIONS

(in person-days)

	Decentralized Custom System	Centralized Custom System	Centralized System under STORET
Detailed Design			
• most likely estimate	270	270	--
• conservative estimate	373	373	332
Programming and Testing			
• most likely estimate	478	478	--
• conservative estimate	568	568	840[1/]
Installation at States/Regions			
• most likely estimate	38 person-days initially plus 55 to 66 person-days per state depending on type of hardware	38 person-days initially plus 49 person-days per state	38 person-days initially plus 49 person-days per state

---

[1/] Includes 400 man-days for STORET documentation.

we do not have the estimates from STORET personnel for this step, it is reasonable to assume that the installation tasks for this option will require roughly the same resources as the centralized custom system.

Implementation Schedule

The previous section showed our estimates on person-days required at each stage of development of the MSIS. This section translates the theoretical concept of person-days into a realistic implementation schedule in keeping with the overall requirements of the Safe Drinking Water Program.

Since the National Interim Primary Drinking Water Regulations stipulate that all community public water systems begin the monitoring activities called for in the regulations in June 1977, our implementation schedule is designed to provide maximum likelihood of achieving this program goal.

Regardless of the system option selected, we believe that the following overall schedule is necessary to accomplish the program objective:

July 1, 1976 to October 1, 1976 : Detailed Design
October 1, 1976 to October 15, 1976 : Detail Design Review
October 15, 1976 to January 31, 1977: Programming and Testing Software at Central EPA Facility
October 1, 1976 : Begin concurrent task of developing state specific formats and procedure.
February 1, 1976 : Begin implementation of MSIS at states, including training and including software installation (for the decentralized option).

The major emphasis of this strategy is to leave as much time as possible for installing the system at the states and regions, since it is the use by states and regions that will ultimately determine the "success" of the MSIS. Thus, the detailed design, and programming and testing of the MSIS must be completed within six to seven months beginning July 1976. We developed a detailed task assignment chart by module for detailed design, programming and testing a custom MSIS, based on a set of most likely and conservative estimates for completion of each discrete task. These charts are displayed in Appendix 2.

These estimates call for five to seven professionals during the detail design phase, and a professional staff of ten to twelve for programming and testing the custom MSIS. This constitutes a very large effort condensed in a relatively short time period; therefore, project management abilities and skills will play a critical role in the successful development of the MSIS.

To further ensure the success of the development effort, our implementation strategy in Appendix 2 highlights the critical modules in the custom MSIS so that the progress on these can be monitored very carefully. Additionally, our task assignment scheme builds in sufficient slack time for critical modules so that they are completed within the overall schedule.

The elapsed time estimates supplied for the STORET option are roughly the same as the schedule outlined above. The EPA personnel estimate about three months for detail design and four months for programming and testing. However, they state that they do not have the resources available to perform the tasks.

In terms of installation at states and regions, our implementation plan shows that portions of the installation tasks that are not related to computer system modules, e.g. finalizing state-specific formats, establishing procedures, etc., should begin immediately after the detailed design is complete.

It is important to remember that the support provided to the states and regions in our plan is considerably more extensive than simply installing a computer system. It includes assistance in establishing procedures at the program level that will eventually interface with the computer systems. EPA may decide not to provide support other than that strictly associated with the computer system, but then the states and regions will have to go through the process of learning to use this management tool on their own and this may cause problems at the state and regional level.

Cost Estimates

Comparison of cost estimates for the various options is complicated by the fact that the "price" or unit cost may be different, especially when costs comparisons are made between internally developed systems and contractor developed systems.

Using an average rate of $275 a day for detail design tasks and $225 a day for programming and system testing tasks, we estimate that the professional services portion of development of the custom MSIS would be between $75,000 and $103,000 for detailed design, and between $108,000 and $128,000 for programming and systems testing. To this must be added the cost of support personnel, travel (if any), and computer time depending on who bears that cost.

The cost of installing a decentralized MSIS at each state would vary with the type of hardware at the state facility; using the above assumptions regarding price per person-day, costs would average approximately $13,000 - $15,000 per state, not including travel and other direct costs.

The STORET-based MSIS system was estimated by EPA personnel to cost approximately $128,000 for both detailed design and programming, and systems testing. However, they used an average rate of $85 per person-day, which is not a realistic figure to use in comparing the development costs of the various systems options since EPA does not have the internal resources to undertake a project of this size and would probably have to contract major portions of the development effort. If this is so, then the internal rate does not provide a good basis for comparison. If a commercial rate of $200 a day is applied to the estimated person-days for development tasks (other than STORET documentation which is estimated at $50,000), then the overall cost of the MSIS based on STORET would amount to about $204,000, compared with a range of $183,000 to $231,000 estimated for a custom MSIS.

In conclusion, therefore, as far as development costs are concerned, all three options of the MSIS will probably require similar outlays from EPA.

VII. ANNUAL OPERATING COSTS OF THE MSIS

In this section we present our comparative analysis of the ongoing operating costs of the MSIS under each option. First, the major assumptions used in computing operating costs for the custom system and that based on STORET are explained; next, our approach to computing operating costs is presented; our estimates of MSIS operating costs are then summarized and finally, we develop a rough guidance for the minimum number of public water systems in a state or territory when a computer-based information system would be effective.

Key Assumptions

Our survey of state data processing facilities shows that most states have access to a medium to large computer and that a majority of these are IBM facilities.[1] Therefore we base our cost estimates on the assumption that the MSIS will operate on a medium to large facility for either the centralized or decentralized options.

An important part of calculating operating costs of an information system is the charging mechanism used. Our survey of the states showed, not surprisingly, that the charging algorithm varies greatly by state. Moreover, the charging mechanism currently used at the central EPA facility varies according to the utilization of the facility. To overcome these complexities and yet present a reasonable basis for comparison, we used the commercial billing rates charged by the AMS Computer Center to compute costs of operating the custom system, and the EPA supplied rates for computing the operating cost of the STORET-based system. Similarly, we have used standard AMS rates for estimating the cost of data input i.e. keypunch and verification.

The other major element in estimating operating costs is the volume of data to be processed. We based our volume estimates on the data collected in the survey of 24 states, since that is the most current information available.

1/Out of 40 states' Drinking Water Units surveyed, 21 have access to a medium or large IBM computer, 11 have access to other computers and 8 do not have access to a computer or do not know which computer is available.

Approach

Since the MSIS will cover only the community public water systems initially, and non-community public water systems two years later, we computed operation costs of a custom MSIS for the first year of operation and the third year of operation. Also, since this custom MSIS comprises a basic package and a set of optional features, we computed operation costs for both.

Since operation costs depend principally on the volume of data processed, we defined three classes of states in terms of the number of PWS's - large states (9000 or more PWS's), medium (5000 to 9000 PWS's) and small states (up to 5000 PWS's). The main difference in computing the costs for the three classes is that a large state will make more computer runs per period thereby not only processing more data than a small state but also process the data more often. We used the data of the states of Massachusetts, Oregon, and Virginia to represent a small, medium, and large state, respectively.

For the STORET-based option, we used the same data preparation costs as for the custom system, and estimated computer processsing costs based on the rates applicable to STORET use supplied by EPA personnel.

In making cost comparisons between the three options, the average cost per public water system provides a reasonable basis for comparison since total costs for any given state can vary significantly based on the estimated numbers of violations, variances and exemptions, and the mix between community and non-community systems.

Finally, for the two options based on centralized systems (STORET-based and custom MSIS), we added on the cost of telecommunications such as line charges and additional hardware at central facility.

MSIS Operation Costs

Table 2 summarizes the estimated operation costs of the basic package of MSIS in the third year under each of the three options. Detailed computations,

Table 2

ESTIMATED ANNUAL OPERATING COSTS OF THE MODEL STATE INFORMATION SYSTEM

BASIC PACKAGE ONLY

3rd Year

	Decentralized Custom System	Centralized Custom System	STORET-based System
Per Public Water System			
Data Preparation and Input	$4.17	$4.17	$4.17
Computer Processing Costs	1.26	1.26	1.24
Technical Support	1.09	0.78	0.69
Teleprocessing Costs	—	0.66	0.54
Average Cost per Public Water System (basic package only)	$6.52	$6.87	$6.64

estimates etc. are shown in Appendix 3. When all public water systems are considered, both community and non-community, the average annual operating cost per public water system is around $6.75 for all three options. The centralized system options have a higher estimated cost principally because of the additional telecommunication network required.

In addition, we also estimated annual operating costs of the full MSIS package which amounts to $7.97 for public water system for the decentralized option in year 3, i.e., including non-community systems. Thus the optional features of the decentralized MSIS would cost roughly 22 percent more than the basic package.

Since the MSIS is initially expected to cover only community systems, we estimated the costs of the custom decentralized MSIS in year 1; average costs per community public water system would be $15.28 for the basic package and $19.67 for the full system. The principal reason for the sharp drop in unit costs projected between year 1 and year 3 is the large number of non-community public water systems being included in year 3, but the sampling requirements for these systems are substantially less than those for community systems.

In order to facilitate detailed operating cost computations, we developed a computer program that will compute operating costs of a custom MSIS by module and sub-system under a variety of assumptions including specific charge structures, options selected and volumes of samples, violations etc. This program will be delivered to EPA; it can be used to project operation costs for specific states based on state specific data.

Minimum Requirements for a Computerized MSIS

Undoubtedly there is a minimum level below which a computer-based MSIS is not economically effective and individual states must eventually determine the usefulness of such a system for their specific application. The analysis presented here is meant as a general guidance to EPA to help plan for the massive effort of installation at the state level of an MSIS under any option.

Assuming that at least one full-time support person in the state's safe drinking water program, a state can effectively monitor the program through manual procedures if it has less than 200 public water systems and not more than one-fifth of them are community systems. These computations are displayed in Table 3. It must be emphasized once again that this minimum reflects a rough "rule of thumb" guidance based on highly oversimplified assumptions. In reality, the effectiveness of a computer-based MSIS will be determined by intangible factors like the state's desire to get more detailed information, perform analyses, the type of monitoring etc.

According to EPA figures (as of November 1975), out of 56 states and territories, six have less than 200 PWSs; namely, Rhode Island, Virgin Islands, Trust Territories of the Pacific, Samoa, Guam and the District of Columbia. There is no new data concerning the number of non-community PWSs. Using an estimated ratio of community PWSs to non-community PWSs of 1:4, then 40 community PWSs indicate approximately 200 PWSs. According to EPA figures (as of June 1, 1976), the last five states mentioned above also have less than 40 community PWSs.

It should be noted that of the remaining 51 states and territories, two states (Indiana and Pennsylvania) probably will not assume primacy and that states which already have an automated data processing system for drinking water monitoring, such as Maryland, Kansas, and Michigan, may not use MSIS or install just part of it.

Table 3

MINIMUM REQUIREMENTS FOR A COMPUTER-BASED MSIS

Manpower requirements for PWS:

Assume a state with 100 community and 400 non-community public water systems

Projected Annual Samples (See volume estimates in Appendix 3)	11,144 samples
Record each sample @ 10 minutes per sample	1,857 hours
Determine violations by community PWSs @ 20 minutes per PWS per month	600 hours
Determine violations by non-community PWSs @ 15 minutes per PWS per month	1,200 hours
Total hours per year	3,657 hours

÷ 500 PWS = 7.31 hours per PWS

Assuming that one full-time support person can spend 1500 hours a year on these tasks, number of PWS monitored is approximately 200 (1500 ÷ 7.31)

Total Annual Costs

Although the operation cost per public water system (PWS) provides a meaningful way of comparing the three options, the discussion would be incomplete without considering total operation costs.

In order to do that, we first had to estimate the number of public water systems that will be monitored using MSIS, and the number of states that will be using MSIS. A discussion of the assumptions used and detailed tables are presented in Appendix 3, and the summary is presented in Table 4.

Total operating costs under the three options are very close, while the costs for the centralized custom MSIS are invariably higher than the cost for the other options. The main difference in the cost structure between the custom decentralized option and the STORET option is that the STORET option would be more costly for EPA and less costly for the states. This is so because STORET is a centralized system and the burden of technical assistance is mainly on the states. It should be noted that ultimately more people will be needed under the decentralized option than under the centralized options, since each state will enhance the basic capabilities of MSIS to suit the individual state's requirements.

Assuming that MSIS will be installed at all the applicable states by June 1, 1978, and that during the first year states will be using mainly the basic MSIS, the total operation cost should be between $700,000 and $800,000. Because the first year of a new ADP system is characterized by mistakes and reruns, it is advisable to add a safety margin of 25% to this amount.

We can assume that by the third year, most of the states will use many of the additional features of MSIS, and therefore the applicable costs are approximately $2,200,000 (this figure already allows for inflation). Operating costs for subsequent years will be higher since there is growth in PWSs numbers and costs tend to increase over time.

TABLE 4

MSIS ANNUAL OPERATING COSTS

($000)

OPTION	FULL MSIS				BASIC MSIS			
	1st Year		3rd Year*		1st Year		3rd Year*	
	People	$000	People	$000	People	$000	People	$000
Total Cost for EPA:								
Custom Decentralized	1.75	35	1.75	40	1.75	35	1.75	40
Custom Centralized	9.00	180	9.00	207	9.00	180	9.00	207
STORET	8.00	160	8.00	184	8.00	160	8.00	184
Total Cost for States:								
Custom Decentralized	24.00	842	58.00	2,076	19.00	669	52.00	1,690
Custom Centralized	18.00	823	46.00	2,048	13.00	628	40.00	1,618
STORET	18.00	804	46.00	2,003	13.00	614	40.00	1,580
Total National Cost:								
Custom Decentralized	25.75	877	59.75	2,116	20.75	704	53.75	1,731
Custom Centralized	27.00	1,003	55.00	2,255	22.00	808	49.00	1,825
STORET	26.00	964	54.00	2,187	21.00	774	48.00	1,764

*Including 15% for cost increase due to inflation.

APPENDIX 1

ESTIMATED RESOURCE REQUIREMENTS FOR MSIS DEVELOPMENT

This appendix displays the detail task lists and estimated mandays per task for the three major steps in developing an MSIS: detailed design, programming and testing, and installation at the states and regions. Exhibits 1.1, 1.2, and 1.3 show the overall task list for system-dependent tasks and module/state dependent tasks for each step.

Detail computations regarding our estimates for module-dependent tasks are contained in Exhibits 1.4 through 1.7, and their derivation is described below:

Estimate of Module-Dependent Tasks

Fifty modules are defined for MSIS. The range of complexity varies from very simple to very complex. In order to arrive at a common denominator for all modules, we evaluated each of them based on five characteristics:

- Number of files which are handled by the module
- Number of different record formats processed
- Number of reports generated
- Complexity level (on a scale of 1 to 5, the same complexity coefficient that is used for computing operation costs)
- An indicator of special processing or calculations.

To each of these factors we assigned a weight, 2, 1, 3, 5, and 4, respectively. The relative level of effort required for completing a module is represented by the number of points computed by multiplying each factor by its weight and summarizing the result.

The factors assigned to each module and the computed number of points are shown in the six left-most columns of Exhibit 1.4. The distribution of modules by the number of points is shown in Exhibit 1.5. It is easy to see that we can distinguish between four levels of difficulty. Group A contains modules with number of points between 10 and 22, with an average of 15. Group B contains modules with number of points between 24 and 36, with an average of 28. Group C contains modules with number of points between 46 and 62, with an average of 54. Group D contains one module with 97 points.

For each group we estimated the number of mandays per point by selecting a typical module from the group and estimating the required mandays for completing each of the module-related tasks. The number of mandays is then divided by the number of points to provide the number of mandays per point. These estimates were done subjectively, based on AMS' long experience in detailed design and programming. The estimates were done twice; the first is an estimate of the most likely level of effort required for performing the task and the second is a conservative estimate. The results of both estimates are shown in Exhibits 1.6 and 1.7.

Using the number of mandays per point, the estimates for every module were computed, as shown in the righthand side of Exhibit 1.4. The same estimates were used to develop the detailed task plans in Exhibits 2.1 to 2.4.

Exhibit 1.1

TASK LIST FOR DETAIL DESIGN OF A CUSTOM MSIS

		ESTIMATED MANDAYS
1.	**System Dependent Tasks**	
a.	Prepare Detailed Project Plan	3
b.	Identify and Resolve Remaining Issues	10
c.	Define all Codes	5
d.	Review the Data Element Dictionary and Modify Editing Rules	5
e.	Review and Modify Files Layout	7
f.	Review Reports; Define Layout	10
g.	Define Layout of All Tables and Intermediate Files	11
h.	Design all Input and Turnaround Forms for Use by EPA Regions	4
i.	Define a Common Method for Specifying Processing Options	4
j.	Prepare Operation Instructions, Including Restart and Backup Procedures	3
k.	Prepare Manual Procedures for Use by EPA Regions	20
l.	Prepare Programming Task Plan and Personnel Assignment	2
m.	Identify Common Processing Functions in MSIS Modules	5
n.	Integrate MSIS Module Into Processing Module	3
o.	Review and Modify as Necessary	5
	TOTAL PROFESSIONAL MANDAYS FOR SYSTEM-DEPENDENT TASKS	97
2.	**Module Dependent Tasks**	
a.	Prepare Programming Specifications Including Detailed Description of Processing Functions and Logic	
b.	Prepare a Module Notebook Consisting of All the Required Information for Programming the Module	
c.	Review and Modify Cost Estimates for Programming	
	TOTAL PROFESSIONAL MANDAYS FOR ALL MODULE DEPENDENT TASKS (Most Likely)	144
	TOTAL PROFESSIONAL MANDAYS FOR ALL MODULE DEPENDENT TASKS (Conservative)	233

Exhibit 1.1 (continued)

	Most Likely	Conservative
3. Total Required Manpower		
● For System-Dependent Tasks	97	97
For Module-Dependent Tasks	144	236
Project Management @ 12%	29	40
TOTAL PROFESSIONAL MANDAYS	270	373

EXHIBIT 1.2

TASK LIST FOR PROGRAMMING AND TESTING OF A CUSTOM MSIS

	ESTIMATED MANDAYS
1. System-Dependent Tasks	
a. Revise Project Plan and Personnel Assignment	1
b. Prepare Acceptance Test for Each Subsystem	10
c. Setup Computer-Based Development Libraries and Shared Code	2
d. Conduct Subsystem Testing	24
e. Conduct File System Acceptance Test	10
f. Implement MSIS at OSI (repeat acceptance tests)	15
TOTAL MANDAYS	62
2. Module-Dependent Tasks	
a. Review Programming Notebook	
b. Coding	
c. Test Data Preparation	
d. Unit Testing	
e. Documentation	
TOTAL MANDAYS FOR ALL MODULE DEPENDENT TASKS (Most Likely)	478
TOTAL MANDAYS FOR ALL MODULE DEPENDENT TASKS (Conservative)	568

3. Required Manpower	Most Likely	Conservative
● For System-Dependent Tasks	62	62
For Module-Dependent Tasks	478	568
Project Management @ 15%	81	95
TOTAL PROFESSIONAL MANDAYS	621	725

EXHIBIT 1.3

TASK LIST FOR INSTALLATION OF A CUSTOM MSIS AT THE STATES

1. Phase I

This phase starts following completion of detailed design system-dependent tasks a through k.

a.	System-Dependent Tasks	ESTIMATED MANDAYS
(1)	Prepare Draft of Implementation Manual	15
(2)	Prepare Draft of User Guide (Exclusion of the Manual Procedures)	5
(3)	Send to All Prospective States for Review	1
(4)	Wait 15 days	
	TOTAL MANDAYS FOR ALL STATES	21

b. State-Dependent Tasks

Visit the State:

(1)	Review AMS Visit Documents	1
(2)	Study and Document the Existing System	5
(3)	Design Forms for Use By State	2
(4)	Recommend Procedures, Reorganization, Manpower, Assignments, Etc.	5
(5)	Prepare Task Plan for Phase II	2
(6)	Estimate Implementation and Operation Costs	2
	TOTAL PER STATE	17 per state

2. Phase II

This phase can be started following successful implementation at OSI.

a. System-Dependent Tasks

(1)	Review Implementation Manual and User Guide, Add Technical Considerations	10
(2)	Prepare Tape Copies of Programs, Tables, and Regulations	3
	TOTAL MANDAYS FOR ALL STATES	13

EXHIBIT 1.3 (continued)

b. State-Dependent Tasks

(1)	Review Task Plan for Phase II	1
(2)	Convert Programs for the State's Computer (if Non-IBM)*/	10
(3)	Implement Programs at the State Computer (Clean Compile)*/	5
(4)	Conduct Acceptance Test	5
(5)	Train State Personnel	3
(6)	Code and Implement State Regulations, and Other Tables	5
(7)	Conduct First Production Run from the Conversion PWSIF	3
(8)	Supervise a Test Production Run of the WAQC Subsystem	10
	TOTAL PER STATE	42

3. Total Implementation Costs

a. System-Dependent Tasks

Phase I	21
Phase II	13
TOTAL PROFESSIONAL MANDAYS	34
Project Management @ 12%	4
TOTAL FOR ALL STATES	38

b. State-Dependent Tasks

(1) Decentralized Custom MSIS-State has IBM Hardware

Phase I	17
Phase II	32
Project Management @ 12%	6
Total Mandays Per State	55

(2) Decentralized Custom MSIS-State does not have IBM Hardware

Phase I	17
Phase II	42
Project Management @ 12%	7
Total Mandays Per State	66

---

*/ For decentralized MSIS only.

EXHIBIT 1.3 (continued)

(3) Centralized Custom MSIS

Phase I	17
Phase II	27
Project Management	5
Total Mandays Per State	49

Page 1 of 3

EXHIBIT 1.4

MODULE EVALUATION TABLE

MODULE	FILES	RECORD FORMATS	REPORTS	SPECIAL CALCULATIONS	COMPLEXITY	TOTAL POINTS	DIFFICULTY GROUP	LEVEL OF EFFORT DESIGN A	LEVEL OF EFFORT DESIGN B	LEVEL OF EFFORT PROGRAMMING A	LEVEL OF EFFORT PROGRAMMING B
MSIS010	5	5	1		2	26	B	4.0	2.5	13.0	11.0
MSIS020	4	3	1		2	22	A	4.0	2.0	10.0	7.0
PWSI010	10	18	1	1	4	62	C	11.0	7.0	23.0	23.0
PWSI020	5	6	1		3	31	B	5.0	3.0	16.0	13.0
PWSI030	1	2	1		2	15	A	3.0	1.5	7.0	5.0
PWSI040	1	2	1		2	15	A	3.0	1.5	7.0	5.0
PWSI050	1	2	1		2	15	A	3.0	1.5	7.0	5.0
PWSI060	1	2	1		2	15	A	3.0	1.5	7.0	5.0
PWSI070	4	3	1		3	26	B	4.0	2.5	13.0	11.0
WAQC010	6	13	1	2	4	54	C	10.0	6.0	20.0	20.0
WAQC020	15	26	1	5	4	97	D	30.0	30.0	60.0	60.0
WAQC030	1	1	1		2	14	A	3.0	1.5	7.0	5.0
WAQC040	1	1	1		2	14	A	3.0	1.5	7.0	5.0
WAQC050	1	1	1		2	14	A	3.0	1.5	7.0	5.0
WAQC060	1	1	1		2	14	A	3.0	1.5	7.0	5.0
WAQC070	1	2	1	1	3	24	B	4.0	2.0	12.0	10.0
WAQC080	1	2	1	1	3	24	B	4.0	2.0	12.0	10.0
WAQC090	1	1	1		1	10	A	2.0	1.0	5.0	3.5

EXHIBIT 1.4 (continued) Page 2 of 3

MODULE EVALUATION TABLE

MODULE	FILES	RECORD FORMATS	REPORTS	SPECIAL CALCULATING	COMPLEXITY	TOTAL POINTS	DIFFICULTY GROUP	LEVEL OF EFFORT			
								DESIGN		PROGRAMMING	
								A	B	A	B
WAQC100	5	8		3		30	B	5.0	2.5	15.0	13.0
WAQC110	1	2	1	2	1	20	A	4.0	2.0	9.0	7.0
WAQC120	6	5	1	4		36	B	6.0	3.0	18.0	15.5
WAQC130	9	15	2	4	1	60	C	11.0	6.5	22.0	22.0
WAQC140	1	2	1	2		15	A	3.0	1.5	7.0	5.0
WAQC150	1	2	1	2		15	A	3.0	1.5	7.0	5.0
WAQC160	1	2	2	2		18	A	4.0	2.0	8.0	6.0
WAQC170	1	2	2	2		18	A	4.0	2.0	8.0	6.0
WAQC180	1	2	1	1		11	A	2.0	1.0	5.0	4.0
WAQC190	1	2	1	1		11	A	2.0	1.0	5.0	4.0
WAQC200	1	2	1	1		11	A	2.0	1.0	5.0	4.0
REGS010	2	4	2	2		22	A	4.0	2.0	10.0	7.0
FEDR010	4	4		2		20	A	4.0	2.0	9.0	6.5
VAEX010	10	19		4	1	60	C	11.0	6.5	22.0	22.0
VAEX020	1	2	1	2		15	A	3.0	1.5	7.0	5.0
VAEX030	1	1	1	2		14	A	3.0	1.5	7.0	5.0
VAEX040	3	4	2	3		28	B	5.0	2.5	14.0	12.0
VAEX050	3	2	1	2		19	A	4.0	2.0	9.0	6.0

EXHIBIT 1.4 (continued)

Page 3 of 3

MODULE EVALUATION TABLE

MODULE	FILES	RECORD FORMATS	REPORTS	SPECIAL CALCULATIONS	COMPLEXITY	TOTAL POINTS	DIFFICULTY GROUP	LEVEL OF EFFORT DESIGN A	LEVEL OF EFFORT DESIGN B	LEVEL OF EFFORT PROGRAMMING A	LEVEL OF EFFORT PROGRAMMING B
SRVY010	4	4	1	3	1	32	B	5.0	3.0	14.0	13.0
SRVY010	2	2	1	2		19	A	4.0	2.0	9.0	6.0
ENAC010	7	15		3	1	46	C	8.0	5.0	17.0	17.0
ENAC020	2	3	1	3		22	A	4.0	2.0	10.0	7.0
ENAC030	2	2	1	2		17	A	3.0	1.5	8.0	6.0
ENAC040	1	2	1	2		15	A	3.0	1.5	7.0	5.0
OPER010	8	13		3	1	46	C	8.0	5.0	17.0	17.0
OPER020	5	6	1	3		31	B	5.0	3.0	16.0	13.0
OPER030	2	2	1	2		17	A	3.0	1.5	8.0	6.0
OPER040	2	2	1	2		17	A	3.0	1.5	8.0	6.0
OPER050	1	2	1	2		15	A	3.0	1.5	7.0	5.0
OPER060	1	2	1	2		15	A	3.0	1.5	7.0	5.0
SELECTION	9	12	1	3	1	50	C	9.0	5.5	19.0	19.0
PROCESSING OPTIONS	1	2		2	1	17	A	3.0	1.5	8.0	6.0

EXHIBIT 1.5

DISTRIBUTION OF MODULES BY EVALUATION POINTS

POINTS	NUMBER OF MODULES	GROUP	AVERAGE POINTS
10	1		
11	3		
14	5		
15	10	A	15
17	4		
18	2		
19	2		
20	2		
22	3		
24	2		
26	2		
28	1	B	29
30	1		
31	2		
32	1		
36	1		
46	2		
50	1	C	54
54	1		
60	2		
62	1		
97	1	D	97

EXHIBIT 1.6

ESTIMATE OF THE MOST LIKELY LEVEL OF EFFORT FOR DEVELOPMENT OF TYPICAL MODULES

	MANDAYS PER MODULE			
TASK	PWSI050	VAEX040	WAQC010	WAOC020
1. Detailed Design				
Prepare programming specifications	1.00	1.75	5.00	25.00
Prepare Module Notebook	0.25	0.50	0.75	4.00
Review Operation Cost Estimates	0.25	0.25	0.25	1.00
Total	1.50	2.50	6.00	30.00
Points Per Module	15	28	54	—
Level of Effort per Point	0.1	0.09	0.11	—
2. Programming				
Review Specifications	0.5	1.5	2.5	4.0
Coding	2.0	5.0	8.0	26.0
Test Data Preparation	0.5	1.0	2.0	5.0
Unit Test	1.5	3.5	6.0	20.0
Documentation	0.5	1.0	1.5	5.0
Total	5.0	12.0	20.0	60.0
Points Per Module	15	28	54	—
Level of Effort per Point	0.33	0.43	0.37	—

EXHIBIT 1.7

CONSERVATIVE ESTIMATE OF THE LEVEL OF EFFORT FOR DEVELOPMENT OF TYPICAL MODULES

TASK	Mandays Per Module			
	PWSI050	VAEX040	WAQC010	WAQC020
1. Detailed Design				
Prepare Programming Specifications	2.0	3.0	6.5	25.0
Prepare Module Notebook	0.5	1.5	3.0	4.0
Review Operation Cost Estimates	0.5	0.5	0.5	1.0
To Total	3.0	5.0	10.0	30.0
Points per Module	15	28	54	-
Level of effort per point	0.20	0.17	0.18	-

2. Programming				
Review Specifications	0.5	1.0	2.5	4.0
Coding	2.0	4.0	8.0	26.0
Test Data Preparation	0.5	2.0	2.0	5.0
Unit Test	3.0	5.0	6.0	20.0
Documentation	1.0	2.0	1.5	5.0
Total	7.0	14.0	20.0	60.0
Points per Module	15	28	54	-
Level of effort per point	0.47	0.5	0.37	-

APPENDIX 2

RESOURCE ALLOCATION PLAN FOR THE DEVELOPMENT OF A CUSTOM MSIS

This appendix contains a detailed module by module allocation of manpower for the detail design, programming, and testing phases in the development of a custom MSIS.

Exhibits 2.1 and 2.2 display an assignment of individuals to module tasks throughout the two major steps in MSIS development. These detail data should be useful to EPA in monitoring progress on a custom system development if that avenue is selected. These charts are based on our "most likely" estimates of resource requirements and completion dates.

Exhibits 2.3 and 2.4 display a similar task assignment based on a "conservative" estimate of completion dates and resource requirements.

All task assignment schedules depict the critical path modules and tasks by astericks (*) so that these can be closely monitored. Additionally, a key element of our task assignment plan is that maximum possible time lag is provided for critical tasks by starting them as soon as possible and the most effective assignment of personnel.

This implementation plan applies to a custom MSIS, whether it is eventually a centralized or decentralized system.

EXHIBIT 2.1

TASK PLAN FOR MSIS DETAILED DESIGN

ESTIMATE OF MOST LIKELY LEVEL OF EFFORT

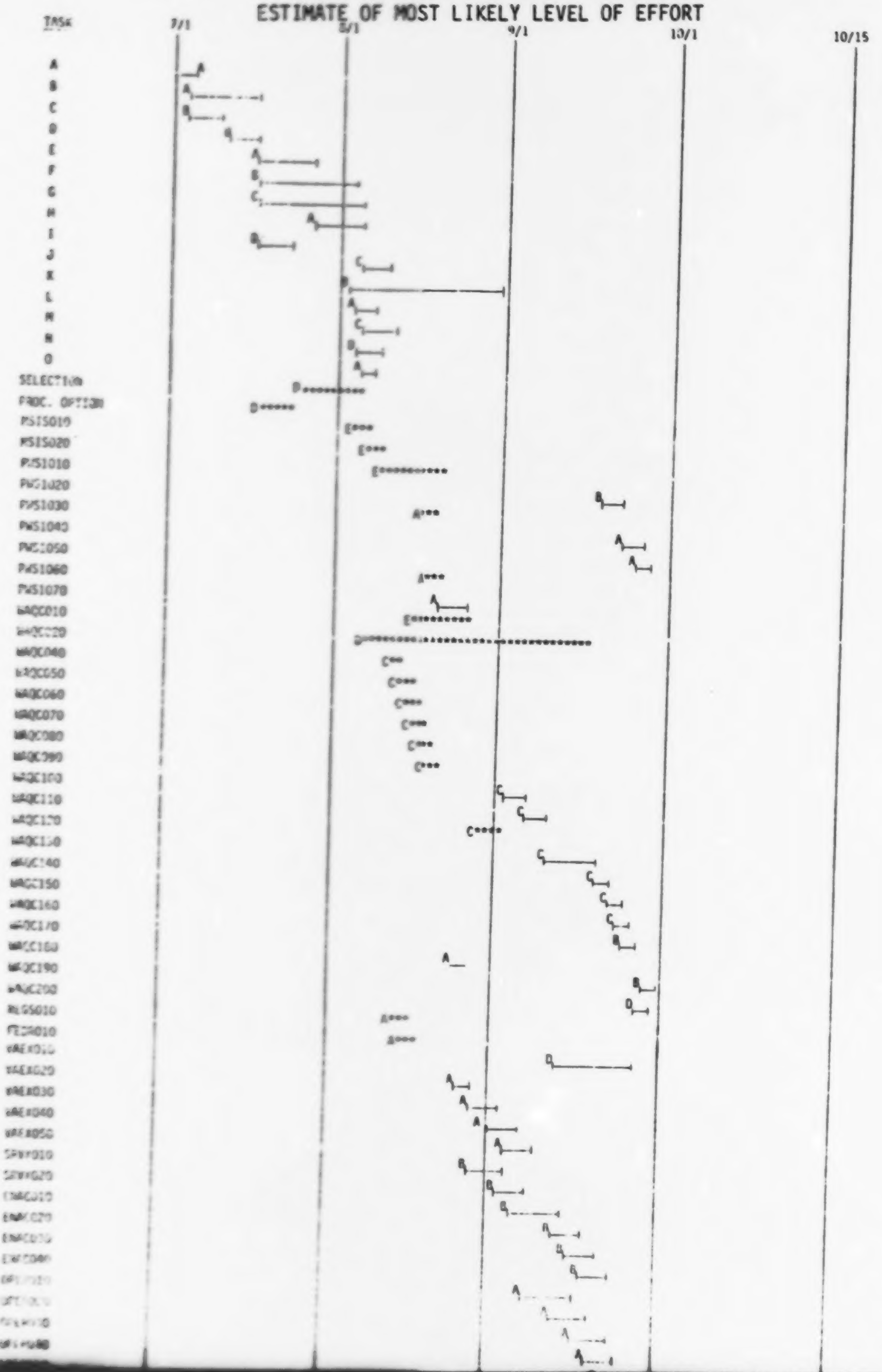


EXHIBIT 2.2

TASK PLAN FOR MSIS PROGRAMMING ESTIMATE OF THE MOST LIKELY LEVEL OF EFFORT

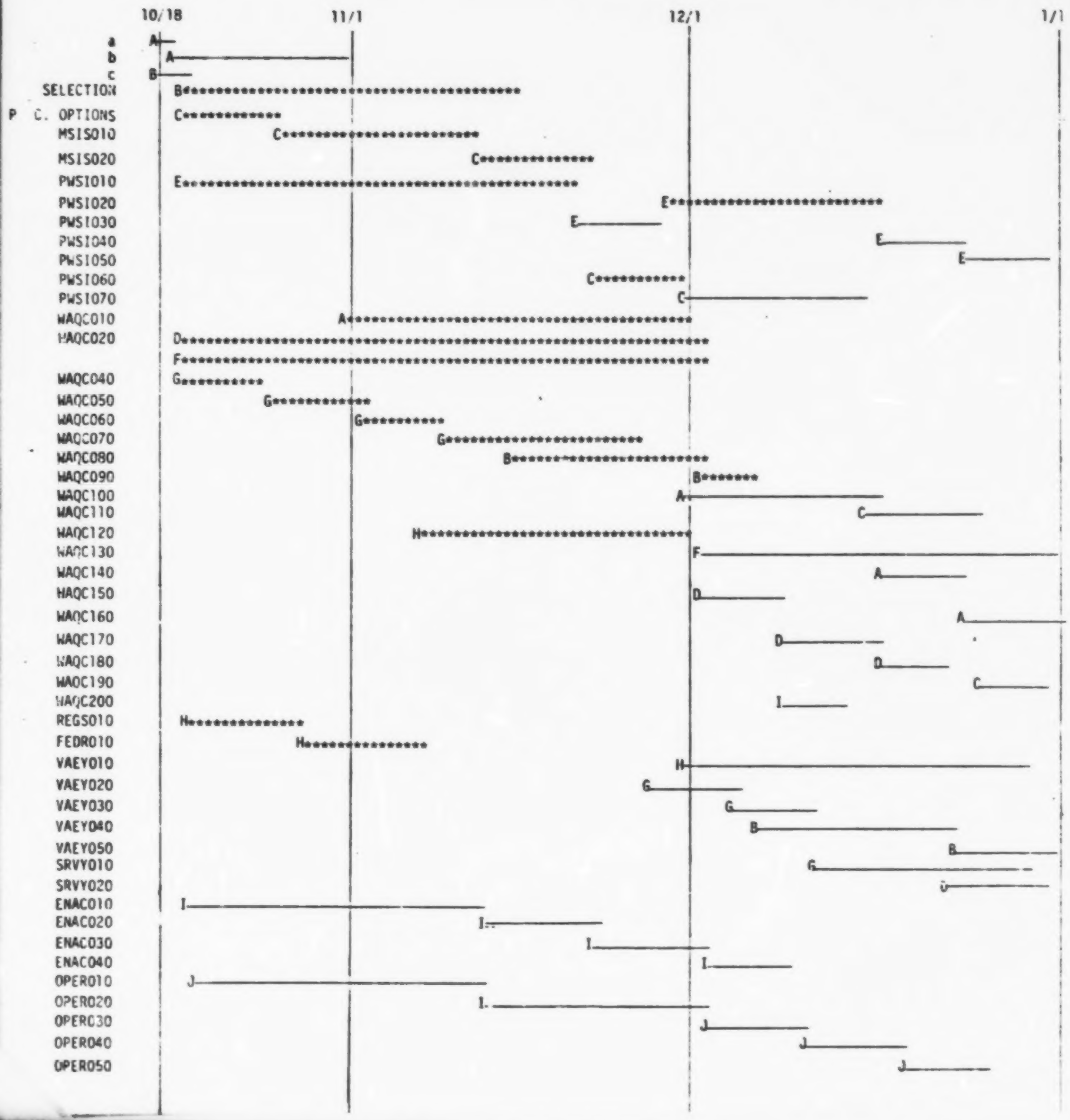


EXHIBIT 2.3

TASK PLAN FOR MSIS DETAILED DESIGN

CONSERVATIVE ESTIMATE OF LEVEL OF ERROR

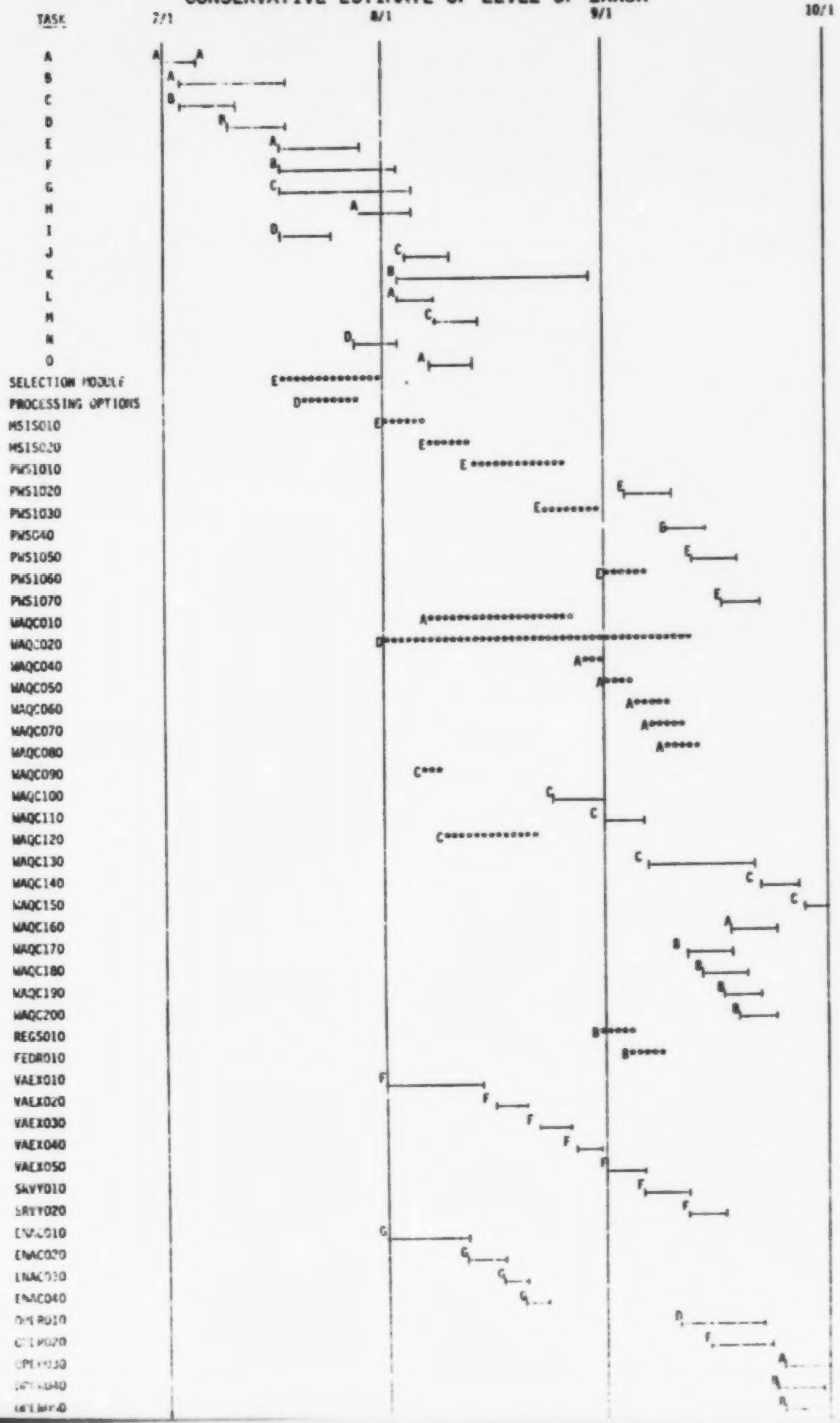
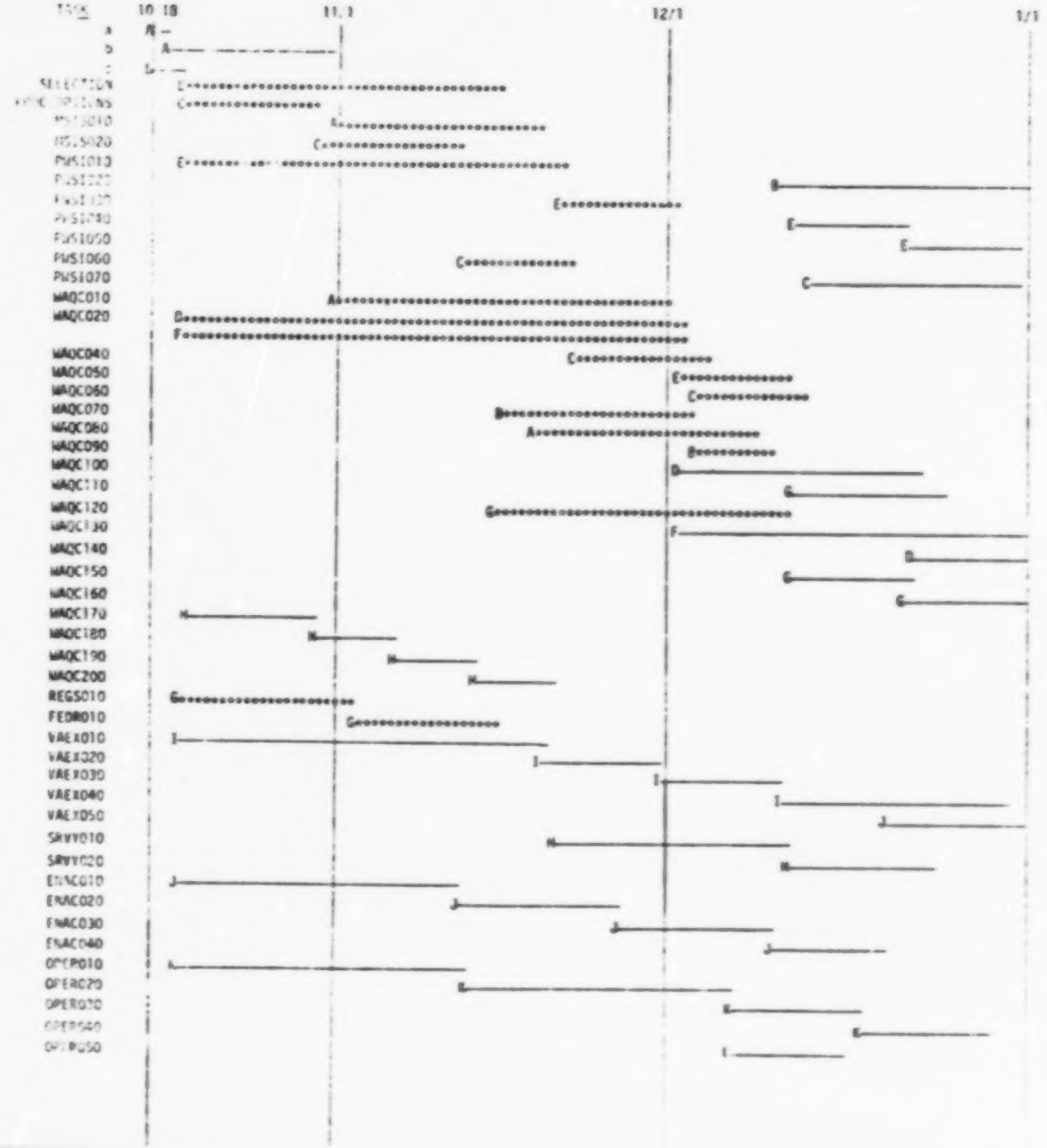


EXHIBIT 2.4

TASK PLAN FOR MSIS PROGRAMMING

CONSERVATIVE ESTIMATE OF LEVEL OF EFFORT



APPENDIX 3

DETAILED EXPLANATION OF MSIS ANNUAL OPERATION COST ESTIMATE

1. Introduction

This appendix contains detailed explanation of the methods and assumptions used to compute the estimates for MSIS annual operation costs. In particular, the following sections discuss these subjects:

- Description of the computer programs developed to compute the operating costs of a custom MSIS
- Estimates of transaction volumes and calculations of the annual operation cost.

2. Cost Computing Program Description

a. Since the custom MSIS comprises fifty modules and sixty-six files, the computation of computer related costs would have been cumbersum, time consuming, and error prone if done manually. Two special computer programs were written in order to perform the computation under various assumptions. Both programs are table driven so that different assumptions may be made by changing external tables. In addition to the benefit of quick, detailed, and error free cost computations, the programs can be used at a later stage to compute estimates of operating costs for individual states.

b. The Cost Computation Program

1. Function:

To accept MSIS parameters and state data and compute annual operation costs.

2. Input:

(a) Assumption table, containing a description of the hardware used and a reference to an internal table (Exhibit 3.1) which relates the level of complexity of a program to CPU time per input record for a variety of widely used computers, and the CPU time required for input output operations.

(b) Charge items, based on AMS Computer Center charge formula (Exhibit 3.2).

NOTE: In order to assist the reader in matching the text and the Exhibits, Exhibits follow the page in the text to which they are first referred. Thus, additional items under "Input" will continue after Exhibits 3.1 and 3.2.

EXHIBIT 3.1

CPU TIME ESTIMATION METHODOLOGY

A. Level of Complexity

1. Very simple. Example: A simple report.
2. Simple. Examples: One record transaction, a simple report with some computation and subtotals.
3. Average. Examples: A transactions consisting of more than one record (card), a complicated report, summary tables, some update programs.
4. Complex. Examples: Transactions requiring sophisticated editing, most update and tracking programs, reports based on heavy calculations.
5. Very complex. Example: Simulation programs.

CPU PROCESS TIME PER INPUT RECORD (MSEC/txn)

Machine / Complexity	360/40	360/65 370/155	370/158	370/165	370/168
1	7.00	1.00	0.75	0.45	0.30
2	28.00	4.00	3.00	1.75	1.10
3	70.00	10.00	8.00	4.75	2.75
4	140.00	20.00	15.00	8.75	5.50
5	210.00	30.00	23.00	14.00	7.75

B. Rough ranges of I/O CPU time (MSEC) assuming programs are writtin in COBOL

Machine / I/O	360/40	370/155	370/158	370/165	370/168
Sequential	3.50	0.50	0.40	0.25	0.20
Direct	7.00	2.00	1.40	0.80	0.60
ISAM	28.00	4.00	2.60	1.40	1.00

EXHIBIT 3.2

A Division of
American Management Systems, Inc.

AMS Computer Center

SCHEDULE B

EQUIPMENT, SERVICES AND RATES

Effective June 1, 1975

Equipment

- IBM 360/65
- 2.5 Megabytes
- 8 spindles of 3330 compatible drives
- 16 spindles of 2314 compatible drives
- 14 dual density tape drives (thirteen 9-track, one 7-track)
- Two 1403 printers (1100 lines per minute)
- 3 selector channels
- 1 block multiplexor channel
- 1 card reader (1000 cards per minute)
- 1 card punch (300 cards per minute)
- keypunches, card sorter, burster, decollator

Software and Services

- OS/MVT
- HASP
- Local Batch
- WYLBUR
- TCAM
- Remote Job Entry (RJE) (2000 BAUD to 9600 BAUD)
- Extensive library of utility and application programs
- On-site or on-call systems software support

Rates

Batch

$$\text{Cost (\$)} = R1(CPU) + R2\frac{(CORE)(CPU)}{(2000)} + R3\frac{(EXCP)}{(1000)} + R4\frac{(CRD)}{(1000)} + R5\frac{(CP)}{(1000)} + R6\frac{(LNP)}{(1000)} + ALLOC$$

CPU = CPU time in seconds
CORE = Core requested
EXCP = Tape and disk I/O's
ALLOC = Private tape and disk allocations

R1 = .12 ($0.12 per CPU second)
R2 = .0015 ($0.0015 per 2K core block per CPU second)
R3 = 1.75 ($1.75 per 1000 EXCP)
R4 = 1.00 ($1.00 per 1000 cards read) ($.50 Remote)
R5 = 3.00 ($3.00 per 1000 cards punched)

R6 = 1.10 ($1.10 per 1000 lines 1-part paper) ($.50 Remote)
1.45 ($1.45 per 1000 lines 2-part paper)
1.80 ($1.80 per 1000 lines 3-part paper)
2.16 ($2.16 per 1000 lines 4-part paper)
2.51 ($2.51 per 1000 lines 5-part paper)
2.86 ($2.86 per 1000 lines 6-part paper)

Private disk allocation.	$1.50
Private tape allocation.	$1.00

Minimum Job Charge	$1.50

Job Scheduling

Priority	*Description*	*Factor*
10	Immediate to ½ hour	2.00
8	Immediate to 1 hour	1.40
5	Immediate to 4 hours	1.00
1	Overnight	.85

Jobs are billed at the lower of priority requested or received.

Block Time Rates

Tape-to-Print	*Tape Copy*
$35.00 per hour	$75.00 per hour

WYLBUR Rates

Connect Time.	$8.00 per hour
Disk Space (2314)	$ .02 per track per day
Disk Space (3330)	$ .04 per track per day

Other Services

Tape Rental.	$ 2.50 per month
Customer Tape Storage. . .	$ 2.50 per month
Tape Purchase.	$14.00 per reel
Tape Cleaning and Certifying.	$ 2.50 per tape
Disk Rental (2314).	$25.00 per month
Disk Rental (3330).	$50.00 per month
Disk Backup (2314)	$15.00 per month
Disk Backup (3330)	$35.00 per month

Customer Disk Storage . . .	$10.00 per month
Bursting	$ 8.00 per hour*
Sorting	$12.50 per hour*
Decollating	$ 8.00 per hour*
Reproducing.	$ .005 per card
Interpreting	$ .005 per card-one pass $ .01 per card-two passes

*Minimum charge of ½ hour

Courier Trip.	Billed at Cost
Keypunching	Estimates given for each job

Paper, cards and other materials billed at 15% above cost.

(c) MSIS parameters, as contained in the following tables:

(1) The Report Table lists all MSIS reports. Every report is assigned an identifying number, and the number of lines that are generated for a single input record. Up to five input files may be specified, and since many reports include lines which are not related directly to an input record, such as headlines and total lines, these additional lines are considered on a percentage basis.

Exhibit 3.3 lists the aforementioned information for all MSIS reports.

EXHIBIT 3.3

MSIS REPORT TABLE

REPORT NUMBER	REPORT NAME	NUMBER OF LINES	FILES A	B	C	D	E	ADDITIONAL LINES (%)
001	Error Report	001	021					008
002	File Update Report	001	001	022				007
003	PWS Condensed List	002	028					007
004	PWS Production and Capacity	001	029					008
005	PWS State Discretionary	002	030					009
006	PWS Comprehensive (Form) Ver.1 (Optional)	015	031	002				000
007	PWS Comprehensive (Form) Ver.2 (Part of Process)	015	024	025	026	027	052	000
008	PWS History	001	003	023				005
009	Sample Transaction List	001	016					002
010	Result Notification (undefined)	005	032					000
011	Chemical MCL Violations	001	034					008
012	Bacti & Turbidity Sampling Violations	002	038					012
013	Chemical Sampling Violations	001	037					012
014	Bacti Summary (Regular) Violations	004	035					008
015	Bacti Summary (Optional)	004	062					008
016	Turbidity Summary (Regular)	002	036					008
017	Turbidity Summary (Optional)	002	063					008
018	Operations Report	001	039					008
019	Chemical Summary	003	064					008
020	Compliance Summary	001	007					010

EXHIBIT 3.3 (continued)

PWSIS REPORT TABLE

REPORT NUMBER	REPORT NAME	NUMBER OF LINES	FILES					ADDITIONAL LINES (%)
			A	B	C	D	E	
021	Operation Report Mailing Labels	001	066					000
022	Chemicals Schedule List	001	040					010
023	Chemicals Sample Form	001	040					020
024	Bacti Sample Form	030 1/	041					000
025	Bacti Sample List	020 2/	042					010
026	Bacti Form Mailing Labels	030 1/	041					000
027	Bacti Summary Form	004	043					000
028	Turbidity Sample List	040	044					010
029	Turbidity Summary Form	004	045					000
030	Regulations Table List	010	004					000
031	V & E Milestone Schedule	010	048					008
032	V & E's in Arrears	010	047					008
033	V & E Condensed List	001	008					006
034	V & E Case History	025	046	050				000
035	PWS by Survey Priority	001	052					006
036	PWS for Survey	001	002	051	052			008

1/ Assuming an average of 4 samples per month per PWS. One record on the file generates all forms.

2/ Assuming an average of 20 samples per PWS generated from one input record.

EXHIBIT 3.3 (continued)

MSIS REPORT TABLE

REPORT NUMBER	REPORT NAME	NUMBER OF LINES	FILES					ADDITIONAL LINES (%)
			A	B	C	D	E	
037	Enforcement Actions Case History	015	053	054				000
038	ENAC Condensed List	001	055					008
039	Operator List	002	056	058				006
040	Distribution List	003	057	059				006
041	Mailing Labels	002	060					000
042	Unspecified Reports	003	061					008

(2) The File Table describes attributes of three types of MSIS files. First, there are permanent files that are kept between production runs and include all MSIS master files and tables. The second type comprises input files that include all the transactions that are input to the MSIS. The third type include intermediate files, which are used to transmit information between steps of a production run.

Exhibit 3.4 lists MSIS file attributes which are (in the order of the table columns, from left to right):

- An identifying number which is assigned to every file.
- File name. For some intermediate files the name is preceded by the name of the module which generates the file.
- Record length (in bytes or characters).
- Average record length (in bytes).

- Blocking factor showing how many records are grouped for storage on the file.
- Organizational method:
  -- S - Sequential file
  -- D - Direct Access file
- An indicator showing if a special setup is required for that file ('Y' = Yes).

The factors that determine the volume of data on a file are listed in Exhibit 3.4, but are not used as input to the Cost Computing Program.

EXHIBIT 3.4

MSIS FILES TABLE

1. **Permanent Files**

ILE NUMBER	FILE NAME	REC L	AVG REC L	BLOCK F	ORG	SETUP	FILE SIZE DETERMINANTS
001	MSIS History	79	79	20	S	Y	Number of Non-PWS Records Number of Updates per Record
002	PWSIF	557 to 1382	667 (2 sources)	2	S	Y	Number of Community PWS Number of Non-Community PWS Phasing Strategy Number of Water Sources
003	PWS History	85	85	20	S	Y	Number of PWSs Number of Updates per PWS Record Phasing Strategy
004	Regulations Table	39 to 860	80	11	S	N	State and Federal Regulations
005	SAF Periodic	80	80	20	S	Y	Number of Samples
006	SAF	73 to 95	87	15	S	Y	Number of PWSs Number of PWSs having Surface Water Source
007	Violations	77	77	20	S	Y	Number of Violations
008	V & E	547 to 3767	1030 (3 milestones)	2	S	Y	Number of V & E's Number of Milestones Per V & E
009	Laboratory Table	80	80	10	D	N	Number of Certified Laboratori
010	Enforcement Actions	534 to 699	567 (3 milestones)	3	S	Y	Number of Enforcement Action C Number of Milestones Per Case
011	Operator and Mailing	117 to 142	142 (operator)	10	S	Y	Number of Certified Operators. Number of Other Addresses
012	Deviations File	59	59	30	S	Y	Number of Violations Number of V & E's

[illegible]

MSIS FILES TABLE (cont'd)

. **Permanent Files** (cont'd)

ILE NUMBER	FILE NAME	REC L	AVG REC L	BLOCK F	O R G	S E T U P	FILE SIZE DETERMINANTS
013	Analysis Method Table	44	44	20	D	N	Number of Analysis Methods
014	PWS Table	53	53	20	D	N	's for PWSIF

EXHIBIT 3.1

MSIS FILES TABLE (CONTINUED)

2. Input Transactions

ILE NUMBER	FILE NAME	REC L	AVG REC L	BLOCK F	ORG	SETUP	FILE SIZE DETERMINANTS
015	PWS Maintenance	80	80	10	S	N	Number of PWSs Updating Frequency Phasing Strategy
016	Sample Data	80	80	10	S	N	Number of Samples
017	Violation Data	80	80	10	S	N	Number of "Other" Violations
018	V & E Data	80	80	10	S	N	New V & E's Updates to Existing V & E Rec Number of Milestones
019	Enforcement Actions	80	80	10	S	N	New Actions Updates to Existing Records Milestones Accomplished
020	Operator and Mailing	80	80	10	S	N	Number of Operators Number of Addresses Updates to the Above
066	Operation Reports	80	80	10	S	N	All community PWSs plus 10% of non-community PWSs

MSIS FILES TABLE [illegible]

3. Intermediate Files

Reproduced from best available copy.

FILE NUMBER	FILE NAME	REC L	[illegible] REC L	[illegible]	[illegible]	[illegible]	FILE SIZE DETERMINANTS
021	Error Files	86	86	20	5	Y	10% of All Transactions
022	MSIS History Updates	80	80	20	5	Y	Number of Monthly Transactions
023	PWS Updates File	121	121	10	5	Y	
024	New PWS records	667	667	[illegible]	5	Y	New PWS's for month [illegible]
025	Incomplete PWS Records	667	667	[illegible]	5	N	10% of PWSIF
026	PWS Status	667	667	2	5	N	10% of PWSIF
027	Unsuccessful Updates	667	667	2	5	N	10% of PWSIF
028	(PWSI020) Condensed List	150	150	10	5	N	10% of PWSIF
029	(PWSI020) Production Data	115	115	12	5	N	10% of PWSIF
030	(PWSI020) State Discretions	130	130	12	5	N	10% of PWSIF
031	(PWSI020) Comprehensive	667	667	2	5	N	10% of PWSIF
032	(WAQC020) Results Notification	100	100	10	5	Y	Periodic Samples (10% of Input
033	(WAQC020) All Violations	80	80	20	5	Y	Periodic MCL & Sampling Violat
034	(WAQC020) Chemical MCL Violations	90	90	20	5	Y	Periodic Number of Violations
035	(WAQC020) Bacti MCL Violations	95	95	18	5	Y	Periodic Number of Violations
036	(WAQC020) Turbidity MCL Violations	73	73	20	5	Y	Monthly Number of Violations
037	(WAQC020) Chemical Sampling Vio.	85	85	20	5	Y	Periodic Number of Violations
038	(WAQC020) Bacti & Turbidity Sampling Violations	90	90	20	5	Y	Periodic Number of Violations

3. Intermediate Files (cont'd)

FILE NUMBER	FILE NAME	[illegible] 1	[illegible]	[illegible]	[illegible]	[illegible]	FILE SIZE DETERMINANTS
039	(WAQC020) Operation Report Violation.	[illegible]	[illegible]	15	5	[illegible]	[illegible]
040	(WAQC130) Chemical Schedule	100	[illegible]	24	[illegible]	[illegible]	[illegible] per Sample
041	(WAQC130) Bacti Schedule-Single Form	120	120	[illegible]	[illegible]	[illegible]	[illegible] Record per PWS
042	(WAQC130) Bacti Schedule-List	120	120	[illegible]	[illegible]	[illegible]	One Record per PWS
043	(WAQC130) Bacti schedule-summary	120	120	[illegible]	[illegible]	[illegible]	One [illegible]
044	(WAQC130) Turbidity Schedule-List	120	120	[illegible]	5	[illegible]	[illegible] PWS
045	(WAQC130) Turbidity Schedule-Summar,	120	120	[illegible]	[illegible]	[illegible]	[illegible] PWS
046	(VAEX010) Deleted V&E's	1000	1000	[illegible]	[illegible]	[illegible]	[illegible]
047	(VAEX010) V&E in Arrears	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
048	(VAEX010) Milestone Schedule	750	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
049	(VAEX010) PWSIF Updates	100	[illegible]	20	[illegible]	[illegible]	[illegible]
050	(VAEX040) Case History Selection	1070	[illegible]	20	[illegible]	[illegible]	[illegible]
051	(VAEX040) Condensed List	66	[illegible]	23	[illegible]	[illegible]	[illegible]
052	(SRVY010) PWS Selected for Survey	150	150	10	[illegible]	[illegible]	[illegible]
053	(ENAC010) Case History	567	567	[illegible]	[illegible]	[illegible]	[illegible]
054	(ENAC020) Case History	567	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
055	(ENAC020) Condensed List	79	79	20	[illegible]	[illegible]	[illegible]
056	(OPER010) New & Incomplete Records (operators)	[illegible]	[illegible]	10	[illegible]	[illegible]	[illegible]

. Intermediate Files (cont'd)

Reproduced from best available copy.

FILE NUMBER	FILE NAME	[illegible]	AVG REC L	BLOCK F	O R G	[illegible]	FILE SIZE DETERMINANTS
057	(OPER01D) New and Incomplete Records (addresses)	[illegible]	117	10	S	Y	[illegible] [illegible]% of Operators
058	(OPER02D) Operator List	[illegible]	142	10	S	Y	100% of Operators
059	(OPER02D) Distribution List	[illegible]	117	10	S	Y	100% of Operators
060	(OPER02D) Mailing Labels	[illegible]	135	10	S	Y	100% of File
061	(OPER02D) Other Reports	[illegible]	130	10	S	Y	100% of File
062	Bacti Summary (selection)	[illegible]	55	10	S	Y	10% of PWSs
063	Turbidity Summary (selection)	[illegible]	73	20	S	Y	[illegible] of PWSs
064	Chemical Analysis (selection)	[illegible]	[illegible]	[illegible]	S	Y	75% of Chemical Samples per Year

4. Tables - One to Represent All Undefined Online Tables

065	Online Table	[illegible]	[illegible]	20	D	N	700 Records

(3) The MSIS Module Table is used to describe the characteristics of all MSIS modules. These characteristics are listed in Exhibit 3.5 and described below (in the same order, left to right, as the columns in Exhibit 3.5).

- Every module is assigned an identifying number.
- The module name is the same as that used in MSIS design.
- Option indicator is used to indicate if the module is optional (the value 'Y') or required for MSIS operation.
- The level of the module is used to indicate if the module has no special features (no value); if it is a summary indicator for a subsystem (the value of '1'), or a module to which special computations apply (the value of '2').
- The complexity level is assigned to a module as explained in Exhibit 3.1.
- The estimated size of computer memory (core) needed for running a module is given in thousands of bytes.
- Up to five output reports may be specified, using the report identifying number.
- To allow up to 16 files to be specified, a "more files" indicator is used (when its value is 'Y') to indicate that a line contains more files specified for the module described in a previous line.
- Up to eight files may be specified in one line. Each file entry contains a file identifying number and an indicator showing if the file is sorted by the module and therefore processing requires additional input/output ('Y' = Yes).

EXHIBIT 3.5

MSIS MODULE TABLE

UMBER	NAME	OPTN	LEVEL	CMPLX	CORE (K)	OUTPUT REPORTS A	B	C	D	E	MORE FILES	FILE (FILE NUMBER/SORT INDICATOR) A	B	C	D	E	F	G	H
001	MSIS010			2	100	001						021 Y	062						
002	MSIS020		2	2	100	002						001	022 Y	001	065				
003	Common Functions		1																
004	PWSI010		2	4	250							002	002	015 Y	049 Y	014	021	022	024
004	PWSI010 (cont.)										Y	025	026	027					
005	PWS020		2	3	200							002	028	029	030	031			
006	PWS030			2	100	003						028 Y							
007	PWS040			2	100	004						029 Y							
008	PWS050			2	100	005						030 Y							
009	PWS060 (Ver.1)	Y		2	150	006						031 Y	002 Y						
010	PWS060 (Ver.2)			2	150	007						024 Y	025 Y	026 Y	027 Y	052 Y			
011	PWS070		2	3	150	008						003	023 Y	003	062				
012	PWS Inventory		1																
013	WAQC010 (Data Entry)		2	4	250	009						016 Y	005	005	021	009	014		
014	WAQC020 (Summary)		2	4	300							005 Y	006	002	004	032	033	034	035
	WAQC020 (cont.)										Y	036	037	038	039	021	006		
015	WAQC030	Y		2	100	010						032 Y							
016	WAQC040			2	100	001						034 Y							
017	WAQC050			2	150	012						036 Y							

EXHIBIT 3.5

MSIS MODULE TABLE (cont'd)

MBER	NAME	OPTN	LEVEL	CMPLX	CORE (K)	OUTPUT REPORTS A	B	C	D	E	MORE FILES	FILE (FILE NUMBER/SORT INDICATOR) A	B	C	D	E	F	G	H
018	WAQC060			2	150	013						037 Y							
019	WAQC070 (regular)			3	150	014						035 Y							
020	WAQC070 (optional)	Y		3	150	015						062 Y							
021	WAQC080 (regular)			3	150	016						036 Y							
022	WAQC080 (optional)	Y		3	150	017						063 Y							
023	WAQC090			1	100	018						039 Y							
024	WAQC100	Y	2	3	250							006	014	062	063	064			
025	WAQC110			2	150	019						064 Y							
026	WAQC120		2	4	250	020						007 Y	007	014	017 Y	021	033		
027	WAQC130	Y	2	4	350	021						002	004	009	066 Y	040	041	042	
027	WAQC130 (cont.)										Y	043	044	045					
028	WAQC140	Y		2	100	022						040 Y							
029	WAQC150	Y		2	100	023						040 Y							
030	WAQC160	Y		2	100	024	026					041 Y							
031	WAQC170	Y		2	100	025						042 Y							
032	WAQC180	Y		1	100	027						043 Y							
033	WAQC190	Y		1	100	028						044 Y							
034	WAQC200	Y		1	100	029						045 Y							
035	WAQC Subsystem		1																

EXHIBIT 3.3

MSIS MODULE Input (cont'd)

UMBER	NAME	OPTN	LEVEL	CMPLX	CORE (K)	OUTPUT REPORTS A	B	C	D	E	MORE FILES	FILE (FILE NUMBER/SORT INDICATOR) A	B	C	D	E	F	G	H
036	REGS010			2	150	030						004	004						
037	Regulations		1																
038	FEDR010			2	200							002	007	008	002	012			
039	Copy ENAC File			1	100							010	010						
040	Federal Reporting		1																
041	VAEX010	Y	2	4	350							018 Y	008	008	021	022	046	047	048
041	VAEX010 (cont.)	Y									Y	049							
042	VAEX020	Y		2	100	031						048 Y							
043	VAEX030	Y		2	100	032						047 Y							
044	VAEX040	Y	2	3	150	033						008	014	050	051 Y				
045	VAEX050	Y		2	150	034						046	050 Y						
046	Variances & Exemptions	Y	1																
047	SRVY010	Y	2	3	100	035						002	007	052	052 Y				
048	SRVY020	Y	2	2	150	036						002	052	052 Y					
049	Sanitary Survey	Y	1																
050	ENAC010	Y	2	3	300							010	019 Y	010	021	022	053	014	
051	ENAC020	Y	2	3	250							010	014	054	055				
052	ENAC030	Y		2	150	037						053	054 Y						
053	ENAC040	Y		2	100	038						055 Y							

EXHIBIT 3.5

MSIS MODULE TABLE (cont'd)

MBER	NAME	OPTN	LEVEL	CMPLX	CORE (K)	OUTPUT REPORTS					MORE FILES	FILE (FILE NUMBER/SORT INDICATOR)							
						A	B	C	D	E		A	B	C	D	E	F	G	H
054	Enforcement Actions	Y	1																
055	OPER010	Y	2	3	300							011	011	020	014	021	022	056	057
056	OPER020	Y	2	3	300							011	058	059	060	061			
057	OPER030	Y		2	150	039						056	058 Y						
058	OPER040	Y		2	150	040						057	059 Y						
059	OPER050	Y		2	100	041						060 Y							
060	OPER060	Y		2	100	042						061 Y							
061	Operator & Mailing	Y	1																

(d) State Data Tables for each state. One table showing the number of records per file and the second table showing all the modules that the state plans to use and the planned number of runs per year. These tables may be prepared by using the State Data Preparation Program (described below).

3. Output

An operation cost report which can be produced at different levels of detail. The most detailed level shows, for each module, all the chargeable items that may be charged to the production of the module, per run and per year. The other levels of detail are per module, per subsystem and per state. See an example of an itemized cost report in Exhibit 3.6.

4. Process

The cost computation program reads all the tables and arranges them in memory. State data is then read and the costs per state are computed, by module, and listed.

EXHIBIT 3.6

AN EXAMPLE OF THE OUTPUT OF THE COST COMPUTATION PROGRAM

(One page of a multipage Report)

```
                    _MODEL STATE INFORMATION SYSTEM - ANNUAL OPERATING COST
DATE 05/11/76                       LEVEL OF DETAIL: ITEM                               PAGE  31
ASSUMPTIONS:        HARDWARE MODEL: IBM 360/65      OPERATING SYSTEM:  OS         MEMORY SIZE: 2560K
STATE: VIRGINIA
               ITEM                QUANTITY      UNITS     CHARGE PER     CHARGE   PER    RUNS PER    ANNUAL
                                  PER  RUN                    UNIT           RUN           YEAR       COST


           SEQUENTIAL IO              224     COUNT      $.00175          $.39        52          $20
           FILE SETUP                   2     COUNT     $1.00000         $2.00        52         $104
           CPU TIME                     2     SECOND     $.12000          $.24        52          $12
           MEMORY/CPU TIME            150     2K/SEC     $.00150          $.23        52          $12
           PRINT LINES               7200     COUNT      $.00110         $7.92        52         $412
*     TOTAL FOR MODULE PWS060 (VER.2)                                   $10.78        52         $560

           SEQUENTIAL IO               36     COUNT      $.00175          $.06        52           $3
           FILE SETUP                   4     COUNT     $1.00000         $4.00        52         $208
           CPU TIME                     5     SECOND     $.12000          $.60        52          $31
           MEMORY/CPU TIME            375     2K/SEC     $.00150          $.56        52          $29
           PRINT LINES                253     COUNT      $.00110          $.28        52          $15
*     TOTAL FOR MODULE PWS070                                            $5.50        52         $286

**    TOTAL FOR SUBSYSTEM PWS INVENTORY                                                        $4,202

           DIRECT ACCESS IO            76     COUNT      $.00175          $.13       200          $26
           SEQUENTIAL IO              395     COUNT      $.00175          $.69       200         $138
           FILE SETUP                   3     COUNT     $1.00000         $3.00       200         $600
           CPU TIME                   184     SECOND     $.12000        $22.08       200       $4,416
           MEMORY/CPU TIME          23000     2K/SEC     $.00150        $34.50       200       $6,900
           PRINT LINES                196     COUNT      $.00110          $.22       200          $44
*     TOTAL FOR MODULE WA0C010 (DATA E                                  $60.62       200      $12,124

           SEQUENTIAL IO             2401     COUNT      $.00175         $4.20       104         $437
           FILE SETUP                  13     COUNT     $1.00000        $13.00       104       $1,352
```

c. The State Data Preparation Program

1. Function

To accept basic state data and prepare detailed state data to be used as input to the cost computation program.

2. Input

(a) A table describing how the volume of MSIS intermediate files is related to MSIS permanent and input volumes.

(b) A table describing the number of runs per year for every module for a typical small, medium, or large state (Exhibit 3.7).

(c) For each state, the data volume of MSIS permanent and input files and a list of optional modules that the state selects to run.

3. Output

State data formatted as input to the cost computation program.

4. Process

Using the tables and the basic state data, the expected volume for each intermediate file is computed. The number of runs per module is computed by referring to the size of the state (in terms of number of PWS's) and the list of optional modules.

EXHIBIT 3.7

NUMBER OF RUNS PER YEAR BY MODULE AND STATE SIZE

	STATE		
MODULE	SMALL	MEDIUM	LARGE
MSIS010	52	104	200
MSIS020	12	12	12
PWSI010	17	26	52
PWSI020	12	26	26
PWSI030	12	26	26
PWSI040	12	26	26
PWSI050	12	26	26
PWSI060	17	26	52
PWSI070	17	26	52
WAQC010	52	104	200
WAQC020	24	52	104
WAQC030	24	52	104
WAQC040	24	52	104
WAQC050	24	52	104
WAQC060	24	52	104
WAQC070	24	52	104
WAQC080	24	52	104
WAQC090	24	52	104
WAQC100	12	12	12
WAQC110	12	12	12
WAQC120	12	12	12
WAQC130	12	12	12
WAQC140	12	12	12
WAQC150	12	12	12
WAQC160	12	12	12
WAQC170	12	12	12
WAQC180	12	12	12
WAQC190	12	12	12
WAQC200	12	12	12

	STATE		
MODULE	SMALL	MEDIUM	LARGE
REGS010	6	6	6
FEDR010	3	3	3
VAEX010	12	12	12
VAEX020	12	12	12
VAEX030	12	12	12
VAEX040	12	12	12
VAEX050	12	12	12
SRVY010	10	10	10
SRVY020	12	12	12
ENAC010	12	12	12
ENAC020	12	12	12
ENAC030	12	12	12
ENAC040	12	12	12
OPER010	12	12	12
OPER020	12	12	12
OPER030	12	12	12
OPER040	12	12	12
OPER050	12	12	12
OPER060	12	12	12

3. Volume Estimates

All data volume estimates were done in accordance with the assumptions specified in the File Table (Exhibit 3.4). Since the volume of intermediate files is related to MSIS permanent and input files, we used the data preparation program to prepare the volume estimates for the intermediate files.

In addition to the assumptions in the File Tables, we used the following guidelines for estimating the data for the purpose of determining operation cost estimates.

- Permanent Files

  The volume is the yearly average, so the number of records that are passed during one run represent an approximation of a typical run.

- Input Transactions

  The volume that was estimated is the number of transactions per run. To this, 10% was added for error corrections.

  Some files require multiple transactions for the creation of a new records:

FILE	TRANSACTIONS
PWSIF	13 + 2 (sources)
SAF (summaries)	3
V & E	12 + 4 x 3 (3 milestones)
Enforcement Actions	11 + 3 (3 milestones)
Operator and Mailing:	
Operator	4
Addressee	3

We also assumed that each record is updated at least once a year.

- **Bacteriological Samples**

  Assumptions:

  - 20% of all PWS's are community. Of these, 50% report using a single sample form, 45% report using a sample list, and 5% report on a summary form.
  - Community PWS's report, on the average, four samples per month.
  - Non-community PWS's report on a single sample form, every three months.

- **Turbidity Samples**

  - 6% of all PWS's use surface water, and must perform daily turbidity tests.
  - 2/3 of the above report on a summary from, 1/3 report every single sample.

- **Chemical and Radioactive Samples**

  - 2 samples per year per PWS.

- **Sample Computation Worksheet**

  Number of chemical samples: (PWSIF x 2) ÷ 12
  Number of turbidity samples: PWSIF x 0.64
  Number of bacteriological samples:
  + Community PWS x 4
  + Non-community PWS x 1/3
  + 10% of the total for re-entry errors

The volume estimates which were used in computing the computer time costs are presented in Exhibit 3.8. These estimates were prepared according to the above mentioned guideline, based on data collected during the states survey.

VOLUME ESTIMATES FOR KEY FILES AND TABLES

FILE/TABLE	UNITS	SMALL STATE (MASSACHUSETTS)		MEDIUM STATE (OREGON)		LARGE STATE (VIRGINIA)	
		1st Year	3rd Year	1st Year	3rd Year	1st Year	3rd Year
MSIS HISTORY	RECORDS	366	562	2348	3460	319	486
PWSIF	RECORDS	700	2730	805	6385	1450	10898
PWS HISTORY	RECORDS	696	5514	804	3772	1446	16632
REGULATIONS	RECORDS	200	200	200	200	200	200
SAF PERIODIC	RECORDS	1840	2970	2120	5806	3708	8760
SAF	RECORDS	5706	32772	5874	27624	10578	74508
VIOLATIONS	RECORDS	534	614	27342	32810	60	72
V & E	RECORDS	5	25	10	50	150	750
LABORATORY	RECORDS	125	125	22	22	31	72
ENFORCEMENT ACTIONS	RECORDS	215	1075	10	50	1560	1872
OPERATOR & MAILING	RECORDS	2000	2210	1100	1210	0	0
DEVIATIONS	RECORDS	539	666	27352	32860	210	822
ANALYSIS METHODS	RECORDS	10	10	10	10	10	10
PWS TABLE	RECORDS	700	2730	805	6385	1450	10898
PWS TRANSACTIONS	TRANSACTIONS	90	455	68	540	61	465
SAMPLE DATA	TRANSACTIONS	850	1634	642	1339	458	1197
VIOLATION DATA	TRANSACTIONS	6	7	2278	3007	6	6
V & E DATA	TRANSACTIONS	1	5	2	5	27	137
ENFORCEMENT DATA	TRANSACTIONS	39	197	2	9	296	343
OPERATOR DATA	TRANSACTIONS	320	353	66	635	0	0
OPERATION REPORTS	TRANSACTIONS	700	900	805	2411	1450	2380
ONLINE TABLES	TRANSACTIONS	200	200	200	200	200	200

4. Annual Cost Computation

In estimating the annual operation cost of a custom MSIS, we considered the following items: data preparation, computer time materials, and technical assistance. The computations were done separately for the first and third year, the three states representing a small (Massachusetts), medium (Oregon), and large (Virginia) states, and for implementation of full MSIS or a basic package.

- Computer Time Costs

  The cost computation programs were used to compute the computer time costs. The result of the computations are summarized in Exhibit 3.9, which also shows the number of PWSs in the three states for the first and third years.

EXHIBIT 3.9

MSIS ANNUAL COMPUTER TIME COSTS

($)

		FULL MSIS		BASIC PACKAGE		NUMBER OF PWS	
STATE	QUANTITY	1st Year	3rd Year	1st Year	3rd Year	1st Year	3rd Year
SMALL	AMOUNT	3482	5528	1549	2256	700	2730
	PER PWS	4.97	2.02	2.21	0.83		
MEDIUM	AMOUNT	5887	14620	3642	6838	805	6385
	PER PWS	7.31	2.29	4.52	1.07		
LARGE	AMOUNT	8684	27382	5893	15146	1450	10898
	PER PWS	5.99	2.51	4.06	1.39		
TOTAL	AMOUNT	18053	47530	11084	24240	2955	20013
	PER PWS	6.09	2.27	3.60	1.09		

- Data Preparation Costs - Keypunch

The assumptions and calculations are presented in Exhibit 3.10. Annual estimates of input transaction volumes were used in this computation, and therefore these estimates are not the same as those used to prepare computer time estimates (see Exhibit 3.8) which were estimates of the transaction volume per production run. It should be noted that violation transactions in Exhibit 3.10 are for violations other than water quality or sampling requirements, while the number of violations in Exhibit 3.8 includes all types of violations.

Since we compute the cost per PWS, the cost computations are done on the total number of transactions and PWSs of all three states.

Transactions that are part of the basic package are marked with an asterisk (*).

The cost of keypunch and verification is based on the commercial rate (as charted by AMS Custom Automated Services) for 40 columns per card.

EXHIBIT 3.10

DATA PREPARATION COSTS: KEYPUNCH

1. ESTIMATED ANNUAL VOLUME OF INPUT TRANSACTIONS

STATE: INPUT FILE	SMALL		MEDIUM		LARGE		TOTAL (3 States)	
	1st Year	3rd Year	1st Year	3rd Year	1st Year	3rd Year	1st Year	3rd Year
* PWS Maintenance	1400	5460	1610	12770	2900	21796	5190	40026
* Samples	40182	68735	60680	126596	83273	217636	184135	412967
* Violations	70	84	0	0	120	120	190	204
V & E	10	10	0	0	300	300	310	310
Enforcement Actions	350	500	20	20	1560	1560	1930	2060
Operator & Mail	2000	2040	1100	1210	0	0	3100	3250
Total (full package)	41652	74279	68756	158732	88153	241412	195575	458837
* Total (basic package)	44012	76829	68516	153296	86293	239552	190235	453197

2. KEYPUNCH COSTS ($)

Using commercial rates for keypunch and verification (including cost of cards), and assuming average of 40 columns per card, the rate is $0.096 per transaction. The figures in the table include an additional 10% for keypunch of reentered erroneous transactions.

	FULL MSIS PACKAGE		BASIC MSIS PACKAGE	
	1st Year	3rd Year	1st Year	3rd Year
TOTAL COST ($) (3 States)	20653	48453	20089	47858
NUMBER OF PWS (3 States)	2955	20013	2955	20013
COST PER PWS($)	6.99	2.42	6.80	2.39
PERSON DAYS*	215.1	504.70	209.30	498.5
PERSON DAYS PER PWS	0.073	0.026	0.071	0.024

*Assuming 10,000 key strokes per hour, 40 strokes for keypunch and 40 strokes for verification, total of 80 strokes per transaction, plus 10%.

- Data Preparation Cost - Personnel (Exhibit 3.11)

There are three types of transactions to be considered.

a. Sample Data

All sample forms are filled and coded at the source (laboratory and PWS). Most of the samples will be reported on sample lists or summary forms. The handling of sample forms is therefore minimal and we can assume that it takes 10 seconds to handle a single sample.

b. Other Transactions

Since the handling of transactions other than sample data varies between the various formats, and since a large portion of PWS maintenance is filled during sanitary surveys and require minimal handling, we assume that on average, a transaction requires 5 minutes of handling.

c. Error Correction

We assume an error rate of 10%. Sample data constitutes the major share of the transactions and the errors. Most of these errors will be keypunch errors which are identified easily. The use of MSIS standard error list reduces to a minimum the clerical handling of errors. In view of all this, we estimate that on average, 2 minutes are required for each error.

The computation of required person-days, as shown in Exhibit 3.11, is based upon the number of transactions, as displayed in Exhibit 3.10. Since our target is to compute the average cost per PWS, the computations are shown for the combined figures of the three sample states. An overhead of 10% is added for management. Clerical cost is based on $10,000 per year for clerical personnel, and $18,000 per year for management; both amounts include overhead.

EXHIBIT 3.11

DATA PREPARATION COSTS: PERSONNEL

1. Number of Transactions (3 states combined)

	FULL MSIS PACKAGE		BASIC MSIS PACKAGE	
	1st Year	3rd Year	1st Year	3rd Year
Sample Data	184135	412967	184135	412967
Other Data	11440	45870	6100	40230

2. Person-Days and Cost

		FULL MSIS PACKAGE		BASIC MSIS PACKAGE	
ITEM	Unit	1st Year	3rd Year	1st Year	3rd Year
Sample Data	Days	63.9	143.4	63.9	143.4
Other Data	Days	119.2	447.8	63.5	425.7
Errors	Days	122.2	191.2	79.2	188.8
Total Clerical	Days	305.3	812.4	206.6	757.9
Mgt. @ 10%	Days	30.5	81.2	20.7	75.8
Total Person Days	Days	335.8	893.6	227.3	833.7
Total Cost	$	14,410	38,345	9,752	35,773
Number of PWSs		2,955	20,013	2,955	20,013
Cost Per PWS	$	4.88	1.91	3.30	1.78
Person-Days per PWS	Days	0.11	0.05	0.08	0.04

- Continuous Paper Cost

  This estimate is based on the number of lines printed. This quantity is an additional output of the cost computation program. The cost is based on the cost of plain 20 lb. paper, assuming 50 lines per page. Exhibit 3.12 shows the result of the computation. The actual cost for a particular state, however, depends on the usage of preprinted forms and the actual price of paper.

- Magnetic Tapes and Disks Cost

  The assumptions and computations are presented in Exhibit 3.13.

EXHIBIT 3.12

CONTINUOUS PAPER COSTS PER YEAR

STATE	QUANTITY	FULL PACKAGE 1st Year	FULL PACKAGE 3rd Year	BASIC PACKAGE 1st Year	BASIC PACKAGE 3rd Year
SMALL	Lines (000)	945	2245	200	481
	Cost	$ 124	$ 295	$ 26	$ 63
MEDIUM	Lines (000)	1736	7564	765	2172
	Cost	$ 228	$ 995	$ 101	$ 286
LARGE	Lines (000)	2147	13873	757	4902
	Cost	$ 282	$ 1824	$ 100	$ 645
TOTAL	COST	380	3114	227	994
	COST PER PWS	$ 0.21	$ 0.16	$ 0.08	$ 0.05

Cost of continuous paper:

1. $15.78 per 2400 pages (20 lbs. paper)
2. Assumed 50 printed lines per page.

EXHIBIT 3.13

ANNUAL COSTS FOR TAPES AND DISKS

a. Magnetic Tapes

Lease of a magnetic tape is $14.00 per year (using AMS computer center rates). Assuming that one tape per permanent file is required every year, then -

Full MSIS 9 x 16 = $126 per year
Basic Package 6 x 16 = $84 per year

The difference in cost between the two packages is negligible, and therefore the higher cost of $126 is considered.

b. Magnetic Disk Space

Assuming the usage of IBM 3330 disks, with cost of $0.04 per track per day ($14.60 per year, AMS computer center rates). For PWS Table, one track per 240 PWS's is required, and we assume additional 20 tracks regardless if the full MSIS or the basic package is implemented.

c. Magnetic Disks and Tapes Cost

STATE	TRACKS		COST FOR DISKS ($)	
	1st Year	3rd Year	1st Year	3rd Year
SMALL	23	32	335.80	467.20
MEDIUM	24	57	350.40	832.20
LARGE	27	66	394.20	963.60
TOTAL	74	155	1080.40	2263.00
COST FOR TAPES			126.00	126.00
TOTAL ANNUAL COST			1206.40	2389.00
COST PER PWS			0.41	0.12

- Teleprocessing Costs

The major single component of teleprocessing is the additional cost that would be incurred at EPA's central computing facility as a result of implementing MSIS centrally and making it available to 56 state and trust territories (although not all of them will use MSIS).

Since teleprocessing costs depend on the volume of data to be transmitted, we estimated this volume by using a factor of 40% to extrapolate from the total number of PWSs as found in our survey of 24 states. Exhibit 3.14 shows the volume estimates. The input data estimates were derived using the same method as estimating the number of samples per state (see Section 3 in this appendix). The number of output lines per PWS is estimated from data shown in Exhibit 3.12.

Using the volume estimated, we estimated the cost of adding a teleprocessing capability separately for the Custom MSIS centralized and the STORET based option. The details are shown in Exhibit 3.15.

EXHIBIT 3.14

ANNUAL DATA VOLUME ESTIMATES FOR A CENTRALIZED MSIS

The estimates are for the basic MSIS package for the third year of MSIS operations.

Based on the survey of 24 states, the number of community PWSs is 42,189 and the number of non-community PWSs is 122,504. We added 40% to these quantities to arrive at an estimate of the total number of PWSs in the U.S.A. The same methodology was used in estimating the number of violations.

The number of sample data transactions and PWS updates was estimated using the same method as discussed in this appendix.

1. Number of PWSs

community : 42,189 + 40% = 59,000
non-community: 122,504 + 40% = 172,000

total estimate 231,000

2. Input data

sample data	5,707,570
PWS updates	462,000
Total	6,169,570
10% for error corrections	616,957
Total Annual Volume	6,786,527
Monthly Volume	566,000
Daily Volume	26,000

3. Output data

Number of lines per PWS	378
Total Number of Lines/Year	87,318,000
Lines per month	7,276,500
Lines per day	346,500

EXHIBIT 3.15

MAINFRAME ADDITIONAL COSTS FOR A CENTRALIZED MSIS

(Basic Package, Third Year)

1. The number of characters to be teleprocessed monthly in:

Input transactions (566,000 transactions x 40 characters)	22,640 K Characters
Output lines (7,276,500 lines x 120 characters)	873,180 K Characters
Total	895,820 K Characters

2. Because the processing will not be spread evenly during the month, there will be needed at least five WATS lines for use by all states on a predetermined schedule.

3. Additional Hardware Costs (monthly)

3. Additional Hardware Costs (monthly)	Centralized MSIS ($)	STORET ($)
5 WATS lines @ $1,800[1/]	9,000	9,000
Dedicated Spindle 3330/2 ($800 x 2.5)[2/]	2,000	0
5 Modems @ $150	750	750
50 K of memory, 11 hours a day[2/]	300	0
Input/output costs @ $1.50 per 1,000	692	692
Total Monthly Cost	12,742	10,442
Total Annual Cost	152,904	125,304
Annual teleprocessing cost per PWS (divided by 231,000 PWSs)	$0.66	$0.54

1/Current and perspective EPA central facility can accommodate the additional lines without having to add another control unit.

2/The costs for STORET already include the additional cost for a dedicated spindle and memory.

- Operation Cost Under the STORET Option

Exhibit 3.16 contains an estimate of the cost to maintain a PWS record and related sample data using STORET. The cost of sample storage was given by EPA as a range of 1.0¢ to 0.016¢ depending on the number of samples stored, and used the average cost of 0.03¢ per sample. The number of samples per PWS was computed by dividing the estimate of 5,707,570 samples per year (see Exhibit 3.14) by the estimated number of PWSs (231,000).

STORET costs include paper costs but not disk and tape costs (estimated at $0.12 per PWS per year). STORET cost does not include the cost of producing other outputs such as a sanitary survey schedule, and is therefore comparable to the MSIS basic package operating costs.

EXHIBIT 3.16

ANNUAL OPERATION COST PER PWS FOR STORET OPTION

($)

Storage of sample data (25 samples per year @ 0.03¢)	0.007
PWS updates (2 per year @ 1.2¢)	0.024
Compliance retrieval (12 per year @ 7.5¢)	0.900
Non-parametric retrieval (12 per year @ 1.6¢)	0.192
TOTAL	$1.123

- Technical Assistance

Regardless of MSIS installation option, one systems analyst is needed at the Office of Water Supply of EPA for monitoring the development, installation, and for providing continuous support to EPA regions and the states.

a. Decentralized MSIS

Since the installation of MSIS at the state includes complete documentation and training, no additional manpower is needed at EPA. One person at each region, however, needs to be familiar with MSIS.

Once MSIS is installed at a state's computer facility, the level of technical assistance should not be more than three months per year of programmer/analyst time. This cost will be higher for a state that expands MSIS on its own, depending on the scope of the changes for system maintenance. Since five of the states and trust territories[1/] are not likely to use MSIS, and two states[2/] will not assume primacy, there will be needed about 12 programmers/analysts. EPA Regions II and V will need 0.25 of programmer/analyst time because they will have to enforce the regulations in Pennsylvania and Indiana. Region IX will also need technical support in order to monitor the 1,000 PWSs in the Indian reservations.

b. Centralized MSIS

Since the states will not be able to modify MSIS themselves, EPA will have to provide for system maintenance and enhancements and this requires at least three programmers/analysts. In addition, each EPA region will need one half programmer/analyst time to assist the states in operating MSIS, and the states need not have local technical support.

[1/] D.C., Guam, Pacific Trust Territories, Virgin Islands and Samoa have less than 80 community PWSs and are not likely to use MSIS at all.

[2/] Indiana and Pennsylvania, in EPA Regions II and V.

c. STORET Option

The level of technical support is estimated by the Data Processing and User Assistance Group of EPA to be two programmer/analysts. In addition, we assume that more user support will be needed at EPA regions at the level of one half programmer/analyst time while there is no need for local support at the state level.

Exhibit 3.17 shows the summary of technical assistance requirements. The cost of programmer/analysts employed by the EPA is computed at $20,000 per year, and those employed by the states at $18,000 per year. The average per PWS in the third year of operation is computed by dividing the costs by 231,000 PWSs. There is not a significant difference between the full or basic package requirements for technical assistance.

EXHIBIT 3.17

ANNUAL COST OF TECHNICAL ASSISTANCE

	CUSTOM DECENTRALIZED		CUSTOM CENTRALIZED		STORET	
	Person Years	Cost ($)	Person Years	Cost ($)	Person Years	Cost ($)
EPA Headquarters	1.00	20,000	4.00	80,000	3.00	60,000
EPA Regions	0.75	15,000	5.00	100,000	5.00	100,000
EPA Total	1.75	35,000	9.00	180,000	8.00	160,000
States	12.00	216,000	0	0	0	0
Total	13.75	251,000	9.00	180,000	8.00	160,000
Cost Per PWS:						
EPA Total		0.15		0.78		0.69
States		0.94		0		0
Total		1.09		0.78		0.69

- Comparison

The three options are compared in Exhibit 3.18 in terms of the average annual cost per PWS of operating the basic package of MSIS during the third year of operations. This cost represents the lower limit of the cost of operating MSIS since during the first two years, the cost per PWS is higher (see Exhibits 3.9 to 3.13) and because using the optional features will also increase the cost (by $1.79) per PWS. The costs are shown by item, and by percentage.

More than 60% of the cost, under all options, is for data preparation, and since the computer time cost is similar (16%), under all three options it is not surprising that in terms of operation costs, the difference between the three options is from $6.52 to $6.87 per PWS; such a difference is not significant.

EXHIBIT 3.18

MSIS OPTIONS COMPARISON TABLE

(Basic MSIS Packages, Third Year)

OPTION

ITEM	CUSTOM DECENTRALIZED		CUSTOM CENTRALIZED		STORET	
	Cost($)	%	Cost($)	%	Cost($)	%
Data Preparation (personnel)	1.78	27.5	1.78	26.0	1.78	26.8
Data Preparation (keypunch)	2.39	36.8	2.39	35.0	2.39	40.0
Computer Time	1.09	16.7	1.09	15.8	1.12	16.9
Paper	0.05	0.7	0.05	0.6	0	0
Tapes and Disks	0.12	1.7	0.12	1.6	0.12	1.8
Teleprocessing	0	0	0.66	9.6	0.54	8.1
TOTAL WITHOUT PERSONNEL	5.43		6.09		5.95	
Technical Support (At EPA)	0.15	2.2	0.78	11.4	0.69	10.4
Technical Support (At States)	0.94	14.4				
TOTAL	6.52	100.0	6.87	100.0	6.64	100.0

- Total Operation Cost

There are two major determinants of total annual operations costs. The first is the MSIS installation strategy, and the second is the operating cost per PWS for these options. We had to make several assumptions concerning the two cost determinants.

a. MSIS Installation Assumptions

(1) Since the installation of MSIS at a state requires at most 60 person days (see Appendix 2), an installation team of three persons can install MSIS in one month. If four installation teams work concurrently, then by June 1, 1978, MSIS may be installed at 49 states and territories.[1/] This assumption is valid for all MSIS implementation options, since implementation of the two centralized options require less than 60 days per state.

(2) Since the implementation of MSIS will start at the beginning of 1977, we can assume that on average, two thirds of the community public water systems will be monitored through MSIS during the first year (June 1977 to June 1978). Using the estimate of 59,000 PWSs, the number of those monitored by MSIS will be 39,500 PWSs.

b. Assumptions About Cost Per PWS

Only the operation costs per PWS for the custom decentralized option were developed also for the full and basic MSIS for the first and third year. For the two other options, we developed only the cost for the basic package and for the third year, since STORET estimates are comparable to the basic package only and the third year included all PWSs.

1/Five territories will not install MSIS, and two states will not assume primacy.

In order to be able to use the operation cost per PWS under all three options, we assumed that the cost for the third year for the basic package is related to the cost for the other cases in the same way under all options. This assumption is valid because more than 60% of the cost is for data preparation and is the same under all the options. The costs per PWS are as follows:

	FULL MSIS		BASIC MSIS	
COST FOR OPTION	1st Year	3rd Year	1st Year	3rd Year
Decentralized	18.58	6.88	14.19	5.43
Centralized	20.84	7.71	15.91	6.09
STORET	20.36	7.54	15.55	5.95

These costs do not include technical assistance.

c. Other Assumptions

(1) During the third year all 231,000 PWSs will be monitored using MSIS (the five territories or states that will not install MSIS together have less than 1,000 PWS, and their effect is negligible).

(2) The cost of technical assistance is shown in its entirety since it is a fixed cost and does not depend on the number of PWSs being monitored.

(3) Costs for the third year include an additional 15% to allow for increase in costs due to salary raises and inflation.

d. Annual Operation Costs

Exhibits 3.19, 3.20, and 3.21 show estimates of the annual operating cost for the custom MSIS decentralized option, the custom MSIS centralized option, and the STORET option, respectively. The cost is shown separately for EPA headquarters, EPA regions, and the states. In each category, the estimated number of additional people required is also shown. The costs under the item "operations cost" are not related directly to the number of people, since they include computer time cost, etc.

EXHIBIT 3.19

ANNUAL OPERATION COSTS UNDER CUSTOM DECENTRALIZED MSIS

	FULL MSIS				BASIC MSIS			
	1st Year		3rd Year		1st Year		3rd Year	
	People	$	People	$	People	$	People	$
COST FOR EPA:								
Headquarters	1.00	20,000	1.00	23,000	1.00	20,000	1.00	23,000
Regions	0.75	15,000	0.75	17,250	0.75	15,000	0.75	17,250
TOTAL FOR EPA	1.75	35,000	1.75	40,250	1.75	35,000	1.75	40,250
COST FOR STATES:								
Technical Assistance	6.00	108,000	12.00	248,400	6.00	108,000	12.00	248,400
Operations Cost	18.00	733,910	46.00	1,827,670	13.00	560,505	40.00	1,442,480
TOTAL FOR STATE	24.00	841,910	58.00	2,076,070	19.00	668,505	52.00	1,690,880
TOTAL COSTS	25.75	876,910	59.75	2,116,320	20.75	703,505	53.75	1,731,130

EXHIBIT 3.20

ANNUAL OPERATING COSTS UNDER CUSTOM CENTRALIZED MSIS

	FULL MSIS				BASIC MSIS			
	1st Year		3rd Year		1st Year		3rd Year	
	People	$	People	$	People	$	People	$
COST FOR EPA:								
Headquarters	4.00	80,000	4.00	92,000	4.00	80,000	4.00	92,000
Regions	5.00	100,000	5.00	115,000	5.00	100,000	5.00	115,000
TOTAL FOR EPA	9.00	180,000	9.00	207,000	9.00	180,000	9.00	207,000
COST FOR STATES:								
Technical Assistance	0	0	0	0	0	0	0	0
Operations Cost	18.00	823,180	46.00	2,048,160	13.00	628,445	40.00	1,617,810
TOTAL FOR STATE	18.00	823,180	46.00	2,048,160	13.00	628,445	40.00	1,617,810
TOTAL COSTS	27.00	1,003,180	55.00	2,255,160	22.00	808,445	49.00	1,824,810

EXHIBIT 3.21

ANNUAL OPERATING COST UNDER STORET OPTION

	FULL MSIS				BASIC MSIS			
	1st Year		3rd Year		1st Year		3rd Year	
	People	$	People	$	People	$	People	$
COST FOR EPA:								
Headquarters	3.00	60,000	3.00	69,000	3.00	60,000	3.00	69,000
Regions	5.00	100,000	5.00	115,000	5.00	100,000	5.00	115,000
TOTAL FOR EPA	8.00	160,000	8.00	184,000	8.00	160,000	8.00	184,000
COST FOR STATES:								
Technical Assistance	0	0	0	0	0	0	0	0
Operations Cost	18.00	804,220	46.00	2,003,000	13.00	614,225	40.00	1,580,620
TOTAL FOR STATE	18.00	804,220	46.00	2,003,000	13.00	614,225	40.00	1,580,620
TOTAL COSTS	26.00	964,220	54.00	2,187,000	21.00	774,225	48.00	1,764,620